AMERICAN ENGINEER AND RAILROAD JOURNAL.

OCTOBER, 1901.

CONTENTS.

AMERICAN ENGINEER TESTS.

Locomotive Draft Appliances.

Preliminary Discussion of Existing Information.

I.

Editor's Note.—This is the first of the series of articles upon the tests of locomotive draft appliances which Professor Goss, of Purdue University, has been engaged to conduct for the American Engineer and Railroad Journal. Their purpose is to bring the information on this subject up to date and supplement what has already been done in order to render it applicable to the very large locomotives of the present time. A number of the best authorities among prominent railroad motive power officers are acting in an advisory capacity and have approved the plans on which the work has already begun. They are in close touch with the undertaking and will co-operate in the effort to reach the desired results. The railroads represented include the Pennsylvania, New York Central, Lake Shore & Michigan Southern, Chesapeake & Ohio, Norfolk & Western, Chicago & Northwestern, "Burlington," Denver & Rio Grande and the Atchison, Topeka & Santa Fe. These are all actively represented by men who have given special attention to this subject, some of them for many years. The preliminary examination of existing data, Mr. H. H. Vaughan's able analysis of previous investigations and his research into "what we know and what we want to know," is the first material to be published. It will be followed by an opinion by Prof. Goss upon the proposed tests, by a report of the meeting of the railroad officers, held in Chicago last spring, a description of the apparatus to be used, a record of the preliminary experiments, a programme of the entire series of experiments, and by observed data, with a final report, by Prof. Goss, upon the entire subject. The circumstances surrounding this undertaking, the interest shown in it by the railroads, and the careful plan, give promise of a final report which will be a classic. We invite criticism and suggestions, and shall leave nothing undone which can in any way contribute to success and save the railroads the expense and annoyance of the large amount of individual experimenting which they are now compelled to bear because of insufficient information on the subject.

In the June, 1900, number of the American Engineer was printed an article from the pen of Mr. H. H. Vaughan, in which the need for further and more exhaustive tests on front end arrangements was discussed. At the time this paper attracted but slight attention, but it nevertheless represented in a general way the ideas of a considerable number of men who have given this subject careful study. Probably no one would resent more quickly than the members of the Master Mechanics' Association committee of 1896 on that subject themselves a statement that the results they obtained were to be regarded as final, and granted this, it is questionable whether, outside of the firebox, there is really a more important feature in the design of a locomotive than the blast producing apparatus, or one from which money expended in determining its most economical form can be so readily recovered. The series of tests carried out by the Master Mechanics' Association had without doubt paid for themselves over and over again, even to the few roads that participated in their expense, by the saving made possible through more accurate knowledge of the principles involved in the action of the blast, and if any further improvement is possible, experiments to determine its form should certainly be made.

As an illustration of the importance of this subject, we might refer to the indicator diagrams published in the American Engineer in November, 1900, which were taken from the new Chicago & Northwestern engine No. 1,017. On some of these cards the back pressure is from 20 per cent. to 25 per cent. of the mean effective pressure, in other words from 16 per cent. to 20 per cent. of the total power developed by the engine is employed in creating the draft necessary for combustion. It is certainly true that even were this back pressure not required in order to obtain sufficient pressure at the nozzle there would always be some few pounds back pressure due to the impossibility of instantly emptying a cylinder of such a size at high speeds, but this necessary loss is small in comparison with that which actually takes place, amounting in one of the cards to as much as 300 horse-power. At the same time it must be distinctly understood that the use of the word loss in the preceding statement is somewhat in error. It is not a loss in the proper sense of the word. It requires a large amount of power to maintain the vacuum in the front end of an engine which is burning coal at the rate of 5,400 lbs. per hour, which is the approximate figure given in the article, and there is no reason to suppose that this instance is an example of inefficient construction. On the contrary we have good reason for stating that the blast arrangements of this engine are in accordance with the best-known practice at the present time. Still, as there is a large amount of work to be done the power absorbed is large and any saving that can be effected in it becomes important and well worth careful consideration. A concrete example of this kind is perhaps hardly required, as it simply serves to add evidence to prove what we can take as freely granted, the importance of any improvement that might be made in our present practice, and the question that now really requires an answer is, "In what direction should further tests be made to obtain greater efficiency in blast appliances?"

Before replying to this question we believe it advisable to answer it somewhat in the Scotch fashion, by an inquiry into what is already known. A great deal of good work has already been performed in experiments on blast nozzles and in this

three series of experiments stand out as pre-eminently reliable and thorough. The experiments carried out by the Master Mechanics' Association committee of 1894 on Exhaust Nozzles and Steam Passages and those of the committee of 1896 on the same subject are in a class by themselves, having been carried out on an actual locomotive on a testing plant, while the Hanover (German) experiments of 1894, described in a paper by Inspector Troske and published in the "American Engineer" in January and the succeeding months of 1896, will always take their place as a most elaborate and careful investigation of the relation between stacks and nozzles.

The report of these latter experiments was presented by Inspector Troske in the form of a paper and opens by a historical review of previous experiments by Clark, Zeuner, Nozo & Geoffroy, Prussman & Grove, all of which is most interesting and instructive reading, although it must be confessed a good deal of the instruction is derived from the demonstration of the erroneous conclusions that can be reached by reasoning from insufficient data or from experiments that do not in every way represent actual conditions. The Hanover experiments are not entirely free from this criticism, as they were not carried out on an actual locomotive, but on a special apparatus designed to give as closely as possible similar results, and to quote from the report "the different shapes of stacks that were investigated were frequently transferred afterward to locomotives under steam and made fast, when precisely the same results were obtained." This method of checking up results obtained on the test apparatus by subsequent transference to an actual locomotive is the guarantee of the reliability of the Hanover tests, and we shall later investigate to what extent these tests confirm or disagree with those carried out by the Master Mechanics' Association committee on actual locomotives on testing plants.

There are two very important points of difference between experiments carried out on a locomotive and on any apparatus to which atmospheric air is admitted, caused by the generally high temperature of the smokebox gases. This may be taken as running from 800 degs. to 1,000 degs. and rarely as low as 600 degs. At these temperatures the weight per cubic foot is about one-third of the weight of the same gases at atmospheric temperature. We should expect from this cause alone that the action of a jet of steam would vary considerably under the two conditions, and without evidence to the contrary should certainly not consider it wise to base any conclusions on smokebox efficiencies on results obtained by apparatus in which atmospheric air is employed. Even should the results be the same in one set of conditions there is no assurance that they would be in others and while we shall refer to this subject later with reference to Troske's report, it certainly is of sufficient importance to demonstrate the advantages of experiments made on a test plant.

A second effect of the temperature of the smokebox gases is their influence on the condensation of the jet. Under ordinary conditions on a locomotive it is almost certain that no condensation of the exhaust jet takes place until after leaving the top of the stack. In fact any admixture with the smokebox gases would tend to superheat the steam in place of cooling it, and this effect is always visible at the stack of an engine in operation, where no steam is visible for several inches from the top of the stack even on the dampest day. In the Hanover experiments in which air was admitted at ordinary temperatures a very different state of affairs was experienced. To quote from the report—"when the apparatus was in blast, the stack emitted the hot condensation of the steam, while showers of water prevailed all about." From this it would appear that considerable condensation took place. In placing dependence on the Hanover experiments, therefore, it must be remembered that this influence might possibly render the results somewhat unreliable as applied to locomotive work, although its extent would very probably be small when the nozzle position was close to the stack and become of greater importance as the distance was increased. In spite of these conditions the Hanover experiments are of considerable importance, especially so far as the shape of the stacks is concerned, and they constitute a most valuable addition to the Master Mechanics' Association series of tests.

The Master Mechanics' Association experiments of 1894, which were completed at about the same time as the Hanover tests, are valuable more from their influence and the suggestions they aroused than from any definite information which was obtained from them, although with the exception of the Hanover experiments, which had not at that time, we believe, been published in America, they furnished the first reliable demonstration of the increased efficiency obtained from the lowering of the exhaust nozzle. Owing to the apparatus used not having sufficient capacity for variation, the full investigation of this feature could not be made, but enough was done to justify the more extensive experiments of 1896 and to serve as a confirmation of the results which had been obtained in this direction on many railroads.

Other variables experimented on in 1894 were the influence of the position of the choke in the exhaust pipe, the form and size of the stack, the angle of the exhaust jet and the most advantageous length of front end. The first three of these points were subsequently more elaborately investigated in 1896, and in view of this fact the 1894 results may be taken as being entirely superseded by the later experiments, but the remarkable influence of the length of the front end, which was the subject of only a few, not entirely conclusive, tests, to the best of our knowledge has not yet been determined and so far as current practice is concerned, the experiments do not seem to be confirmed by experience in service to a sufficient extent to make the results convincing.

The 1896 tests, apart from the information obtained, are also valuable from their proof that a steady flow of steam from the nozzle gave results in every way similar to the actual discharge when the engine is running, thus confirming the assumption made in carrying out the Hanover tests. Definite results were arrived at, determining the relative efficiency of single and double nozzles, the best position of the choke in the exhaust pipe, the proper form of nozzle tip, the variation in vacuum with the position of the nozzle and several forms of stacks, and the relation between size of nozzle and vacuum. The action and form of the steam jet were investigated and a series of tests on the modifying action of the petticoat pipe was carried out without leading to any satisfactory conclusion. In all, these experiments were most complete and satisfactory so far as they went and are without question the most valuable and convincing that have ever been carried out. The Hanover experiments, however, while simply directed to three variables, namely, size of nozzle, distance of nozzle from stack and form of stack, were far more elaborate with respect to these features than the tests of the Master Mechanics' Association, as no less than five sizes of nozzles and 18 different stacks were experimented on at varying nozzle distances, in many cases each of these stacks being tested with different lengths. It is therefore of great importance to compare these experiments with those of 1896, with a view to their mutual confirmation, as in case of their substantial agreement we should have command of an amount of information that would place the relations of stack and nozzle in a position that may be taken as definitely settled, while discrepancies would indicate the direction in which further investigation is desirable.

A considerable number of other experiments have been made from time to time on this subject, but while valuable in themselves and satisfactory so far as the particular object in view was concerned, they have not been carried out in a manner that permits of their use to determine what might be termed the present state of the art, and we believe that the three series of tests above mentioned constitute all the reliable information which has so far been obtained on this subject.

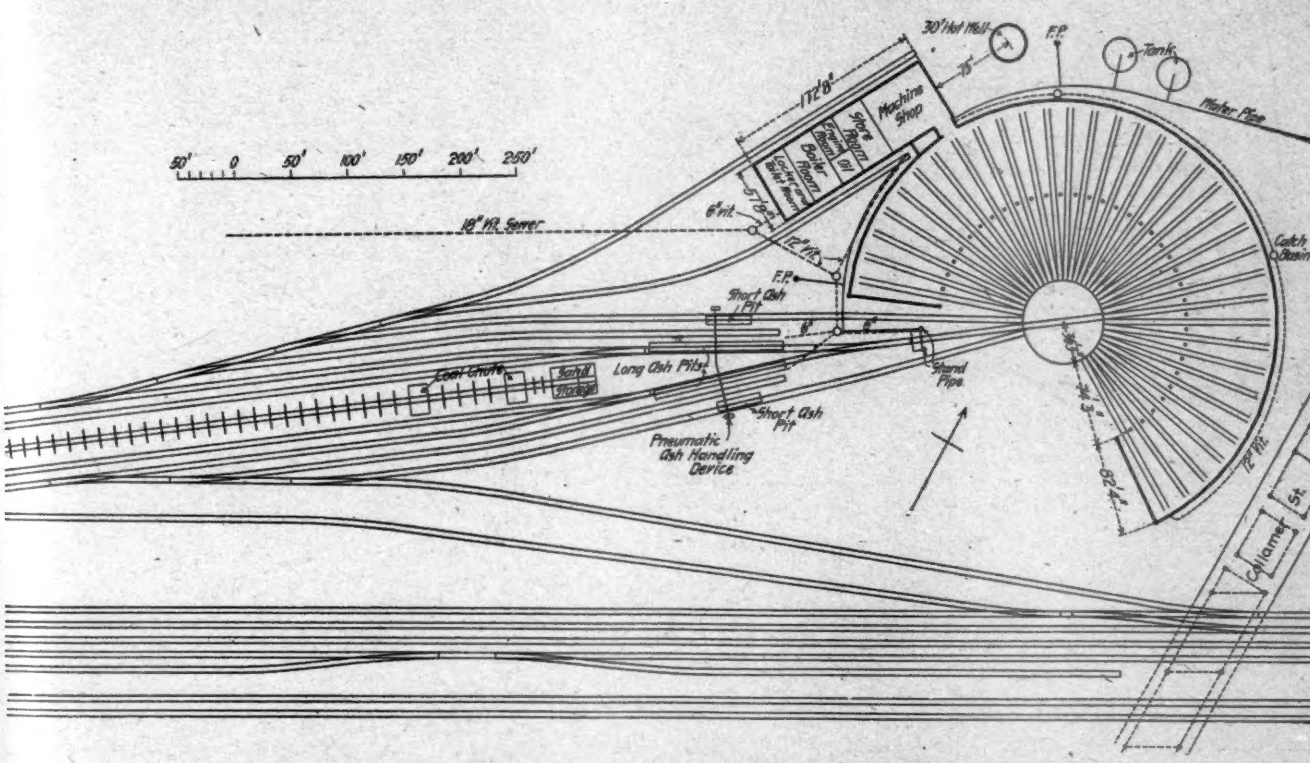
(To be continued.)

AN UP-TO-DATE ROUNDHOUSE.

Lake Shore & Michigan Southern,

At Collinwood, Ohio.

At Collinwood, near Cleveland, Ohio, the Lake Shore & Michigan Southern Railway has just put into service a new roundhouse plant which is noteworthy in the completeness of its appointments and furnishes exceptional facilities for dealing with locomotives at a division terminal. The roundhouse has 35 stalls, with provision for 15 more when required and it is understood that the whole plant may be doubled in capacity by the addition of another roundhouse if that becomes necessary. The accompanying drawings illustrate the track arrangement and location of the roundhouse, the shops connecting with it, the oil, coal, ash and sand handling facilities and the locker and toilet rooms for the men. Provision is made for admirable equipment of drop pits and of piping for blowing off and washing out boilers. In the roundhouse there are five lines of piping reaching all the pits and located overhead in the roof framing. Toward the outside of the circle is a 1½-in. blower pipe with ¾-in. outlets reaching down between the pits, convenient to the front ends. Next in order is a 4-in. water pipe with 2½-in. branches at alternate spaces between the pits; inside of this is a 5-in. blow-off pipe over the domes of the engines with 2½-in. connections through which the steam may be blown down from the boilers into an underground reservoir near the roundhouse where it condenses and heats the water used for washing out and filling boilers. A 4-in. washout pipe has 2½-in. connections between alternate pits and the piping system is completed by a 1½-in. air pipe with ½-in. branches between alternate pits whereby all the engines may be reached. The locations of all these pipes may be seen in the sectional view of the building. It will be noted that the roof trusses and posts are of wood, this being done to



New Round House—Lake Shore & Michigan Southern Railway, at Collinwood, Ohio.

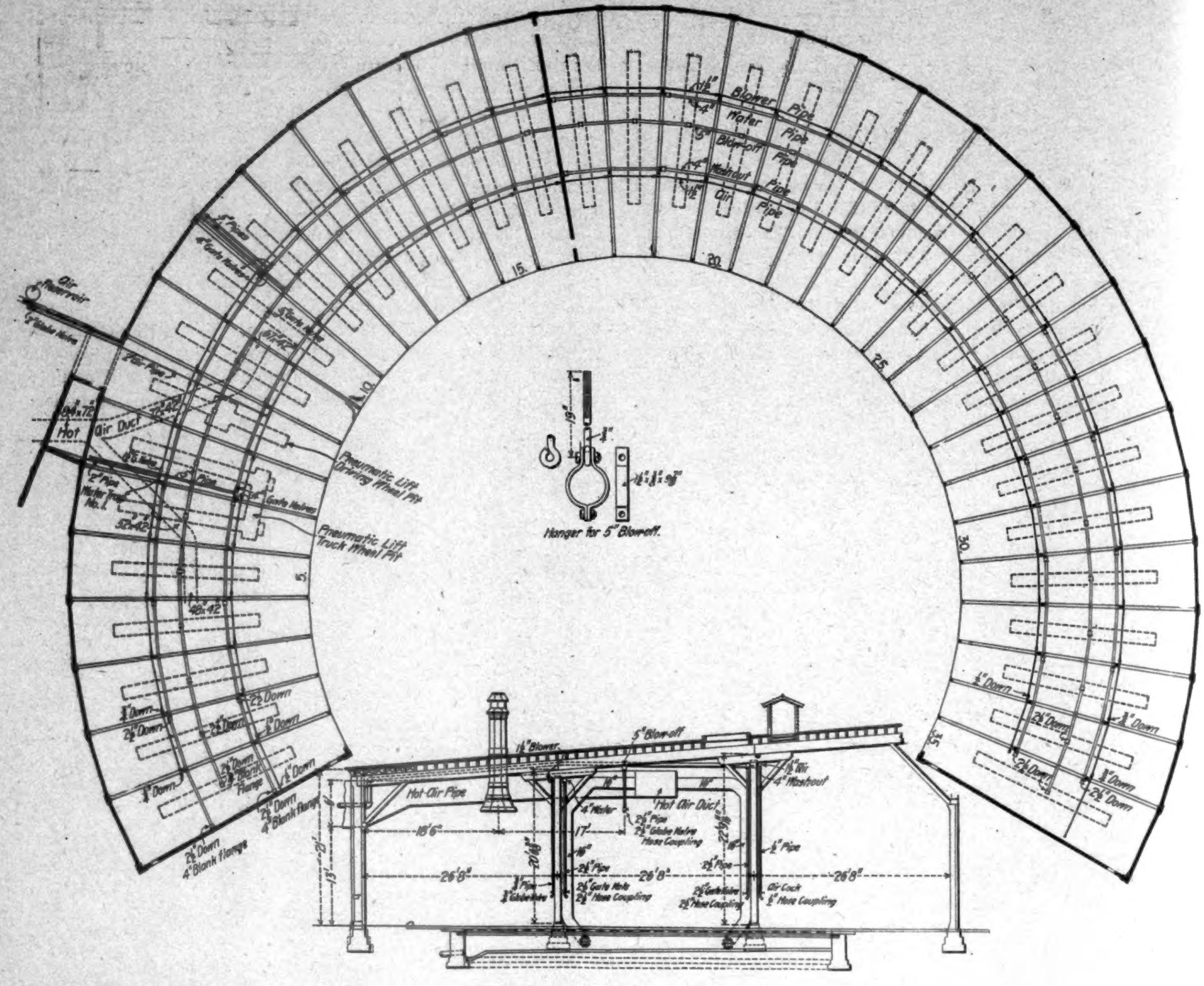
another complete roundhouse which will be placed so as to bring the machine shop and office between the two roundhouses. The chutes, ash pits and sand-house will then be duplicated.

A duplicate arrangement of tracks and ash pits provides for a congestion of the outside work and permits of taking coal, sand and water from either side of the coal chutes. Additional tracks are provided for reaching the roundhouse outside of those next to the chutes. Each of the ingoing tracks has a long ash pit sufficient for two engines and there are also two short pits for cleaning the ash pans of engines leaving the roundhouse after having remained there long enough to render cleaning necessary. At each pair of ash pits a pneumatic ash hoist is provided, one hoist serving a long and a short pit. The long pits will accommodate four engines at once, each of these pits being 120 ft. long. One of the objects of the plan is to permit of expeditious work at the terminal and the coaling, sanding and ash cleaning are progressive operations as the engines go to the house.

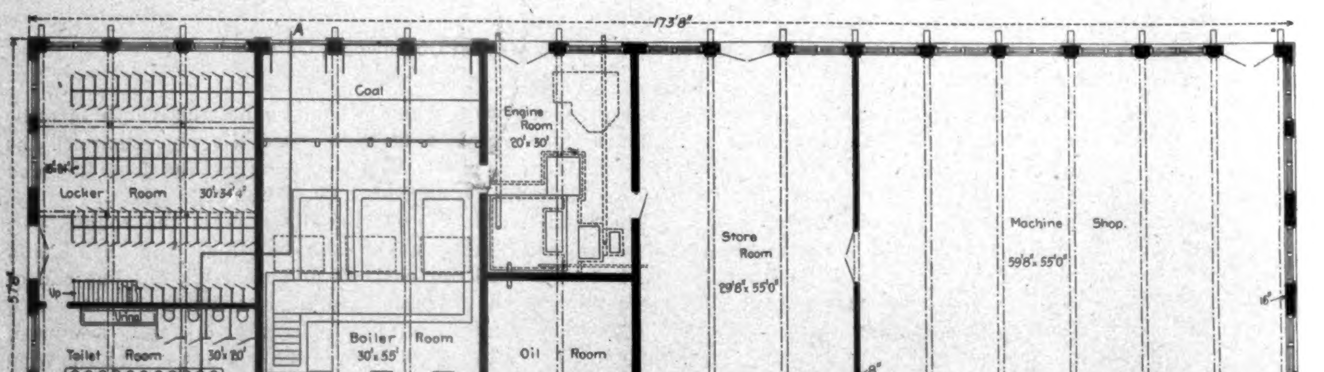
The turntable is 72 ft. in diameter and is driven by power. The roundhouse is one of the largest in diameter ever built. It is heated by the Sturtevant fan system and is provided with an avoid the corrosion which would be destructive to metallic construction. A drain of 12-in. hard tile pipe encircles the building on the outside with a branch leading from the end of each pit under the wall of the building.

The shop building is entered direct from the roundhouse, with the office between the two buildings, the shop being reached by a track for coal, oil and material. At one end of the building is the machine shop, next to this is the storeroom and next the oil room, with two floors for a gravity system of supply. Even with the oil room is the engine room and beyond this the boiler room and coal storage, while the end of the building is devoted to a two-story locker room with 300 lockers for the engineers, firemen and shopmen, and the necessary toilet facilities.

Throughout, the plans provided for a reduction of the labor charges to the minimum and the treatment of the entire problem has been liberal, with a view of quick service in order to assist in securing the most favorable mileage of locomotives. One of the noteworthy features is the ash handling equipment with pneumatic hoists, so arranged as to be operated by one man and involving a small expense for masonry and superstructure. In this arrangement the locomotives may stand at

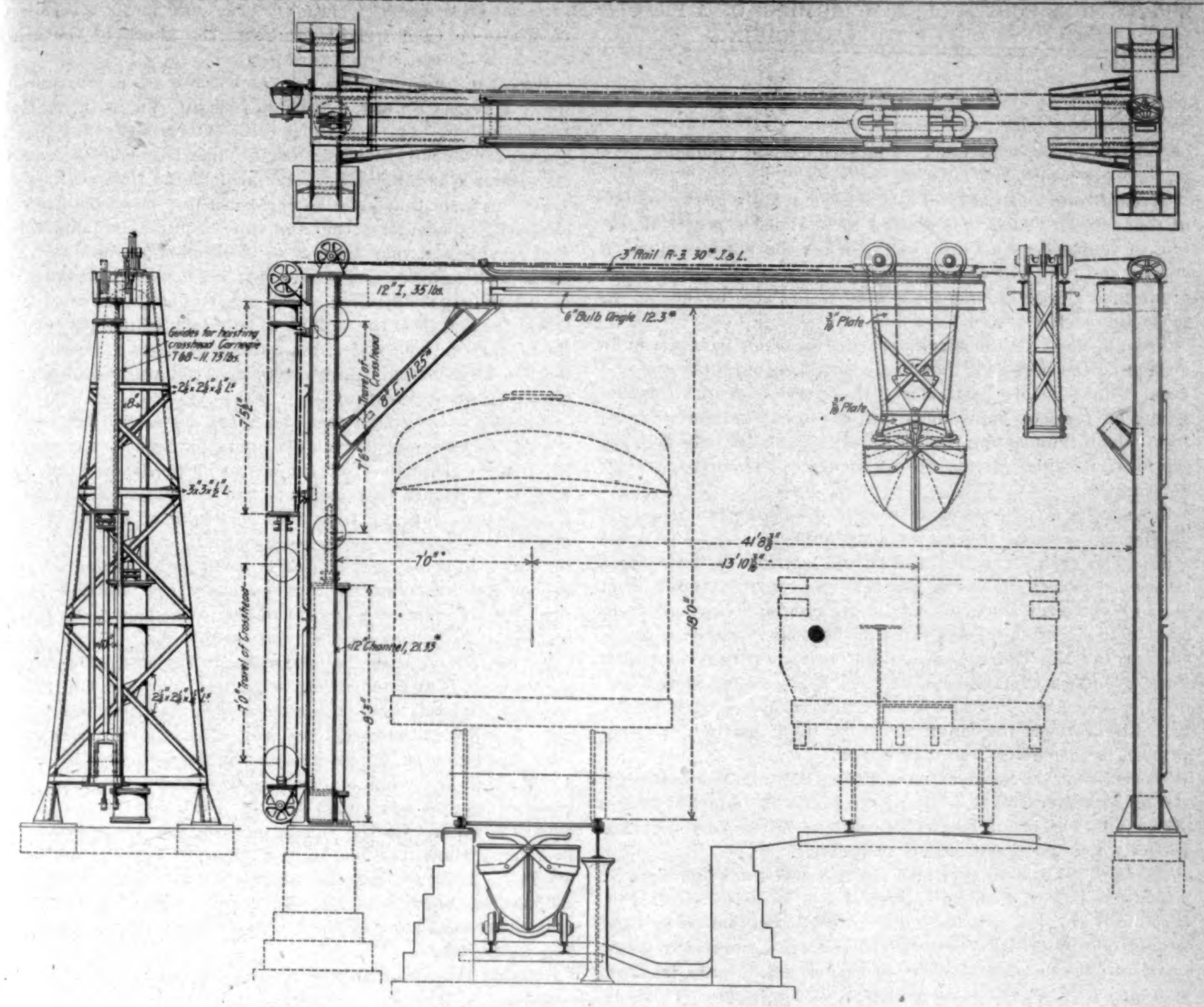


Plan and Section of House.

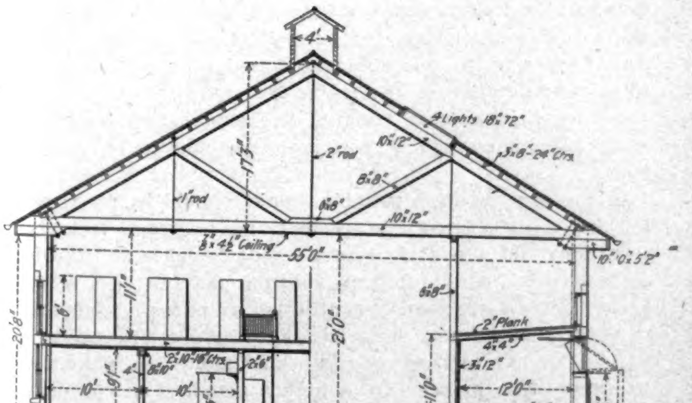


Plan of Machine Shop in Connection with Round House.

Collinwood Round House—Lake Shore & Michigan Southern Railway.



Pneumatic Ash Elevator.



Cross Section Through Machine Shop.

any desired position as long as the ash pans are over the pits. The shop facilities are intended to provide for all the repairs which may be handled advantageously at the roundhouse to the relief of the main shops. Some of the interesting details will be reserved for a later issue.

Every subject relating to methods of increasing locomotive capacity without involving an increase of weight and size is attractive at this time, when so much steam is demanded. An unusual interest is taken in water purification, which is noticeable in widely separated sections, and managements now seem to be ready to appropriate large sums for experimental applications, with a view of favoring boilers by reducing the work required of them. This is an indication of advancement along lines which are sure to be profitable. In spite of everything, the locomotive of the future must be large and heavy. It is important to give it every advantage which tends in the direction of increased capacity per unit of weight, and much may be accomplished by securing in every possible way the best available water. When locomotive boilers are taxed to their utmost to supply steam they should not be expected to work freely when badly scaled, and they will unquestionably respond satisfactorily to methods which will relieve them from the duty of purifying their own water supply. Indications point to the study and general improvement of boiler waters as one of the most notable movements of its kind concerning locomotives. It is decidedly encouraging to note the number of roads which are making wholesale analyses of their water supply and within a short time the installation of a large number of purification plants may be expected. One of the strongest influences in this direction is that which comes with a large demand for engines because of heavy business. This renders the loss of time due to the necessity for washing out boilers exceedingly important. Further advantages, which are not, however, so easily noticed by operating officials, lie in the reduction of boiler and firebox repairs, which are greatly improved by treatment of water in bad water districts.

SUGGESTIONS FOR THE ESTABLISHMENT OF A PRACTICAL SYSTEM OF TONNAGE RATING.

By B. A. Worthington,

Division Superintendent, Southern Pacific Company.

Given a railroad of several divisions, moving a heavy volume of tonnage, on which it is desired to establish a practical system of tonnage rating that will produce the most economical results and that will be as free as possible of theoretical error arising from false assumptions, what is the best method of introducing such a system?

Make a check of the actual practice on each freight run to determine the best load that has been taken on both time and dead freight. Note particularly the speed over the limiting points on the run, so as to arrive at the engine piston speed, from which the traction can be closely calculated. By dividing the load into this traction the resistance can be approximately determined.

In a similar way the resistance can be determined at all points on the run without the use of a dynamometer car. It is essential that such a practical test should be made, as established resistance curves of recent years have been formulated from data obtained on track of very high standard; in fact, from particular sections of heavy rail and thoroughly ballasted track, such as the New York Central line between Albany and New York, from which I understand the "Engineering News" formula was derived. The resistance will vary according to the size of the rail and the conditions of the track, whether properly aligned, ballasted and well maintained.

To arrive at the value of momentum, Wellington's table No. 118 of "Velocity Heads," shown on pages 335 and 336 of his "Economic Theory of Railway Location," gives very accurate results which check out closely in practice.

To make the system applicable to different kinds and sizes of locomotive power, a unit of power should be established. For example, 1,000 lbs. of available locomotive traction to be considered one unit. By "available" locomotive traction I mean traction that can be utilized in service; in other words, traction that comes within the adhesive power of the engine. Then, as shown in the following paragraph, ascertain the load that can be taken at varying speeds over each section of track with one unit of power.

An "operating profile" should be constructed by checking over each section of track from the detailed track profiles, plotting the equivalent grades and velocity heads, making due allowance for resistance from curvature. The column of velocity heads will correspond to the vertical distance from which momentum alone can lift a train moving at any given velocity head against the force of gravity, and measures the work which has already been done in accelerating the train to a given speed. The method of making this operating profile is very clearly described in the "Bulletin of the American Railway Engineering and Maintenance of Way Association" for November, 1900. The equivalent profile will naturally modify the actual profile, velocity heads being plotted along the track and lines drawn joining these velocity heads, measuring the grades, the resistance from which equals the power consumed or acquired by change of speed or elevation. From these lines a table may be readily prepared showing the load that may be taken at different speeds with each unit of engine power. The question of constructive weight allowance for empty and underloaded cars should be carefully considered, as on gradient sections only the rolling and atmospheric resistance are greater per weight unit of empty cars than per weight unit of loaded cars.

With this data at hand, time lines can be readily prepared for rating purposes, but in making the operating profile it is important that no uniform assumptions should be made to apply to radically different conditions as to train lengths or as to the speed that can be attained in a given distance on gradient sections after a start. Both of these points can be easily determined on each freight run from the check of the service suggested in the second paragraph.

With the foregoing data worked out, we are now required to make a rating on say a 120 mile freight run, with an eight-hour schedule. The first thing to be determined is the time required for stops, which necessarily must be deducted from the eight-hour schedule, as the remainder of the time really represents the work that must be performed by the locomotive. My experience teaches me that the time required for stops in actual service will vary from 25 to 30 seconds per mile on valley lines, to 2 minutes and 30 seconds on heavy grade lines, the variation being controlled by the physical characteristics of the track, the length of the sidings to hold long trains, the facilities for taking coal and water, the number of stops to be made, the method of handling train orders and the volume of tonnage moved in each direction.

Suppose we ascertain that two hours are needed for stops on the run in question, leaving six hours for actual running time. We further ascertain from the operating profile that 100 Ms of load (1 M equals 1,000 pounds) can be taken within the six hours' actual running time with each unit of engine traction, and by reference to the operating profile we make a time line for this load showing the speed in miles per hour and the number of minutes required between every two stations on the run, this information being furnished to the superintendent for his guidance in making the time card.

We next arrive at the units of power in the locomotives, which should be done by calculating the traction, limiting the traction, however, on heavy grade lines to one-fifth the driver weight and on valley lines to about 23 per cent. of the driver weight. The limit was placed at 25 per cent. on Southern Pacific lines, but is a trifle high and has a tendency to overload the engines. Suppose an engine has 20,000 lbs. of available traction, which equals 20 units. On the run in question the gross load would be twenty times the 100 Ms, or 2,000 Ms, but the net rating would be 2,000 Ms less the weight of the engine, tender and caboose, say about 1,750 Ms, which is the figure that would appear upon the rating sheet for the information of dispatchers and yardmasters.

Suitable tonnage manifest reports for conductors should be made, and suitable daily train reports for division officers should be made and sent to the general office daily, showing the train number, the freight run, the potential (required) ton mileage, the actual ton mileage, the percentage of efficiency that the actual bears to the potential, the actual running time and the total running time of the train, the character of the freight (whether time or dead freight) and explanation of variation in trainload from required rating and explanation of all delayed time.

In the general office suitable blanks should be prepared for keeping a daily record of performance on each freight run separately and a monthly report should be made and furnished each division superintendent, showing not only his performance, but the performance on all other divisions in comparison, in order that he may see what the others are doing, as this will enable him to know when he is dropping behind and tends to prompt him to keep up as high a standard of efficiency as possible.

The foregoing will give an idea of the system that has been worked out on the Pacific System lines of the Southern Pacific Company, the results from which for the fiscal year ending June 30th, 1901, during which time the tonnage rating system was under my charge, are shown by the following table.

The movement of 13 per cent. heavier volume of tonnage for 5 per cent. increase in locomotive and train mileage, with only 5.4 per cent. increase in the cost of conducting transportation, is certainly a very gratifying showing. The increase in the gross tons hauled per engine mile from 604 to 651 tons speaks for itself. When it is considered that this new system of tonnage rating is compared with a previous system that was in use for three years, the year 1900 being the best performance

in the history of the company, the full value of this new system may be better understood.

	Increase 1901 over 1900	1901.	1900.
1. Tons freight carried one mile, or revenue ton mileage	13.2 per cent.	3,401,942,407	3,001,156,642
2. Gross ton miles handled	13.2 "	8,742,154,000	7,720,024,000
3. Freight locomotive miles	5 "	13,434,986	12,790,358
4. Freight train miles	5 "	10,553,125	10,057,162
5. Total cost of conducting transportation	5.4 "	$16,701,705	$15,971,454
6 Per cent. conducting transportation to earnings		33.4	35.1
7. Conducting transportation per train mile		$0.83	$0.83
8. Earnings per freight train mile	8.5 "	$3.05	$2.81
9. Gross tons moved per engine mile	7.8 "	651	604
10. Average number cars per train	7.5 "	25.7	23.9
11. Tons freight per loaded car	2.3 "	17.57	17.18
12. Tons freight per locomotive mile	7.9 "	253.22	234.64
13. Tons freight per train	8 "	322.36	298.41

Anyone who has given the system of tonnage rating much thought or study will readily understand that it is impracticable to arrive at a mathematically exact system of engine rating, owing to the complexity of the conditions and constantly varying factors involved, which forces us to deal with approximations gained from the best obtainable data to be found and from our own experience. However perfect a theoretical system of tonnage rating may appear, when attempting to put it into practice many obstacles will necessarily be encountered, and the purpose of this article is simply to suggest to others a method for overcoming many of the obstacles which will be met. It is well to avoid all assumptions, as they necessarily lead to false conclusions. A check of the performance can be easily made and data that is more or less reliable can be obtained.

The foregoing is respectfully submitted in the hope that it will enable others to avoid the troublesome obstacles which we have had to overcome in establishing what seems to be the most practical system of tonnage rating in use in this country.

A SYSTEMATIC PLAN OF APPRENTICESHIP.

Baldwin Locomotive Works.

Mr. N. W. Sample, who is well known for his long service as Superintendent of Motive Power of the Denver & Rio Grande, has been placed in charge of the apprentices at the Baldwin Locomotive Works, and, since February last, has given them his entire attention. These works now employ 9,700 men, and with the completion of extensions to the plant the number will probably soon reach 12,000. Naturally such an establishment has always had apprentices. With about 90 per cent. piecework conducted under a contract system, however, the boys did not have a fair chance and, as stated in the editorial columns of this issue, the results were far from satisfactory, and a systematic method of dealing with the problem of educating "all around" men seemed to be an absolute necessity.

The apprentices now number 750, of whom 115 are indentured under the new plan, which divides them into three classes, and the application blank indicates in the explanatory note requirements of these classes. Special prominence is given to educational qualifications in the first two classes, while a third class provides for the shop training of technical school graduates. Of the newly indentured apprentices 70 per cent. are in the first class and 15 per cent. in each of the others.

The usual legal form of indenture is followed for the first two classes. The first class requires four years' service and the age limit is placed so that the boys will finish at the age of 21 years. It is expressly stipulated that the apprentice must "faithfully attend at least two evenings in each week during the first three years of his apprenticeship, free night schools, such as during the first year will teach him elementary algebra and geometry and during the remaining two years will teach him the rudiments of mechanical drawing. * * * It is understood that the apprentice already has a grammar-school education, or sufficient to render it unnecessary that any provision should be made for his further instruction."

The second class requires three years' service and requires advanced grammar or high school training, the upper age limit being 18 years. During the service the apprentice must "faithfully attend at least two evenings in each week during the first two years of his apprenticeship, free night schools which will teach him the rudiments of mechanical drawing."

APPRENTICE'S APPLICATION.

Burnham, Williams & Co.:

Gentlemen: I desire to become an apprentice in your employ, to learn the trade of...
I was...............years of age at my last birthday, which occurred on the...............................day of..........................19......
am sound in body, industrious and intelligent, having attended......
.... school, and have a knowledge of the following studies, viz.:
....
....

If my application is considered favorably, I am willing to be indentured for the necessary term of years.

Respectfully yours,

....

Note.—Applications for indenture as first-class apprentices will be considered from boys who have had a good common school education, and are not over seventeen years and three months of age. The compensation for this class is five cents per hour, first year, seven cents per hour second year, nine cents per hour third year, and eleven cents per hour fourth year, with the further sum of $125.00 at expiration of term of apprenticeship.

Applications for indenture as second-class apprentices will be considered from boys who have had an advanced grammar or high school training, and are not over eighteen years of age. The compensation for this class is seven cents per hour first year, nine cents per hour second year, and eleven cents per hour third year, with the further sum of $100.00 at expiration of term of apprenticeship.

Applications for a special course of instruction, covering a period of two years, will be considered from young men over twenty-one years of age who are graduates of colleges, technical schools or scientific institutes. The compensation for this class is 13 cents per hour for the first year and 16 cents for the second.

All three classes are to be moved or changed in the shop, the first two classes every three months and the third class at their own request, subject to the approval of the superintendent. In order to arrange the moving system systematically and to keep a complete record of the work, the conduct and character of service of each, a blank form is used, a portion of which, the section for the first year, is reproduced here. These blanks, when completed, contain the record of each apprentice for his entire service, together with every foreman's opinion of him.

BALDWIN LOCOMOTIVE WORKS.

Apprentice Record.

Name.........................., Age............years..............months,
Address..., Class..................
Date of indenture................................19..... Shop.................

First Year.

Time.	Expires.	Employed on.	Services were.	Conduct.	Rate per hour.	Sig. of Foreman.
1st 3 mos.	....	....	....	....	....	....
2d 3 mos.	....	....	....	....	....	....
3d 3 mos.	....	....	....	....	....	....
4th 3 mos.	....	....	....	....	....	....

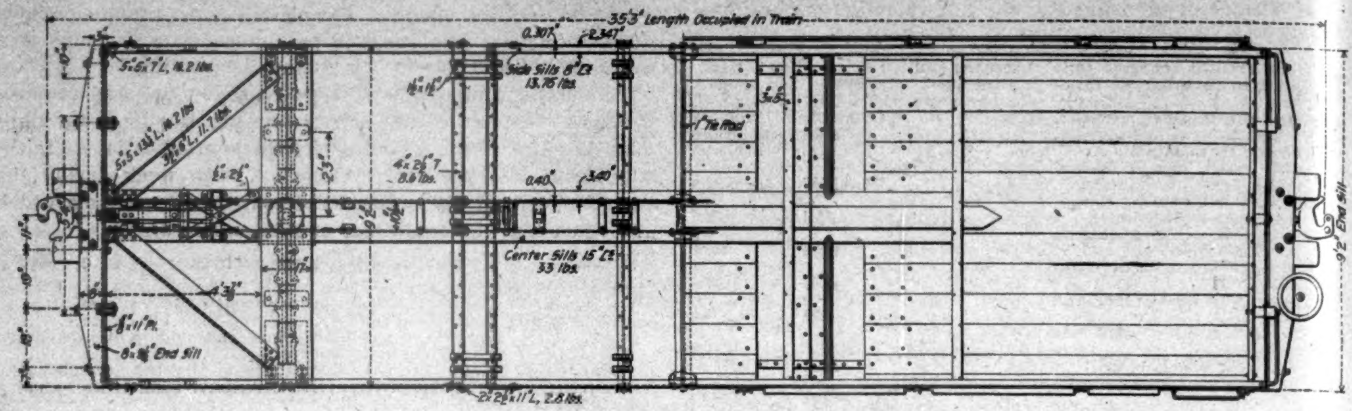
Remarks.

....

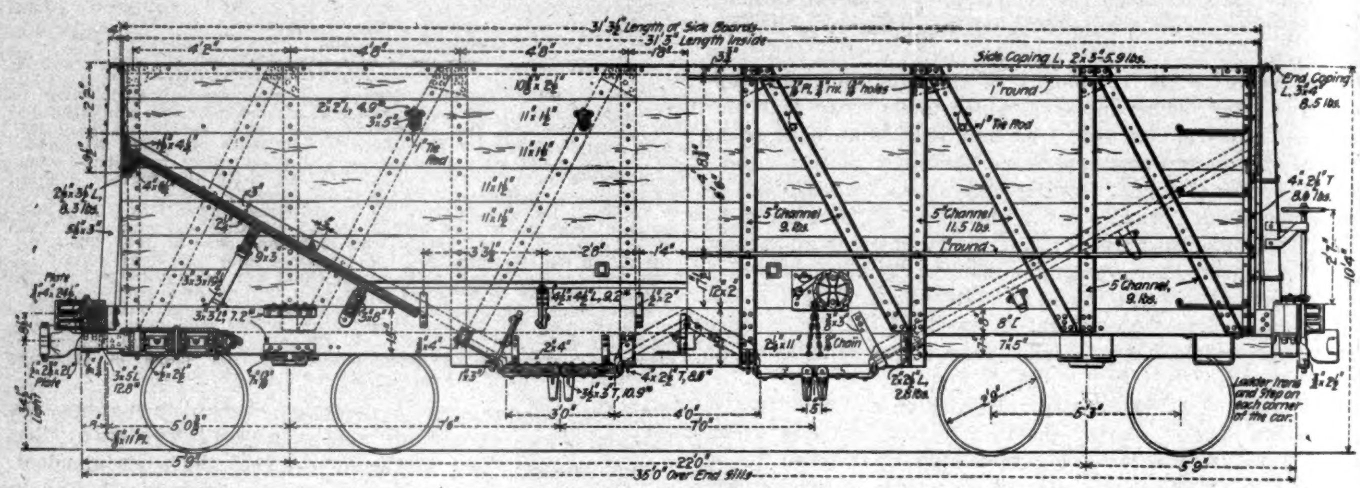
Note.—Apprentices will be changed from one machine or job to another once every three months. Apprentices must not be transferred from one department to another without consultation.

While not definitely stipulated, it is understood that the completion of the apprenticeship leaves the company free to offer further employment to all three classes or not, according to the need for men at the time. At this point the personal record is valuable, and it is obvious that if one who has taken the first or second grade has studied faithfully and made his value apparent he may even pass those of the third or technical class. At least there is nothing to prevent his doing so. It is generally understood that this is a possibility and that at the end of the training all apprentices will stand where their records place them.

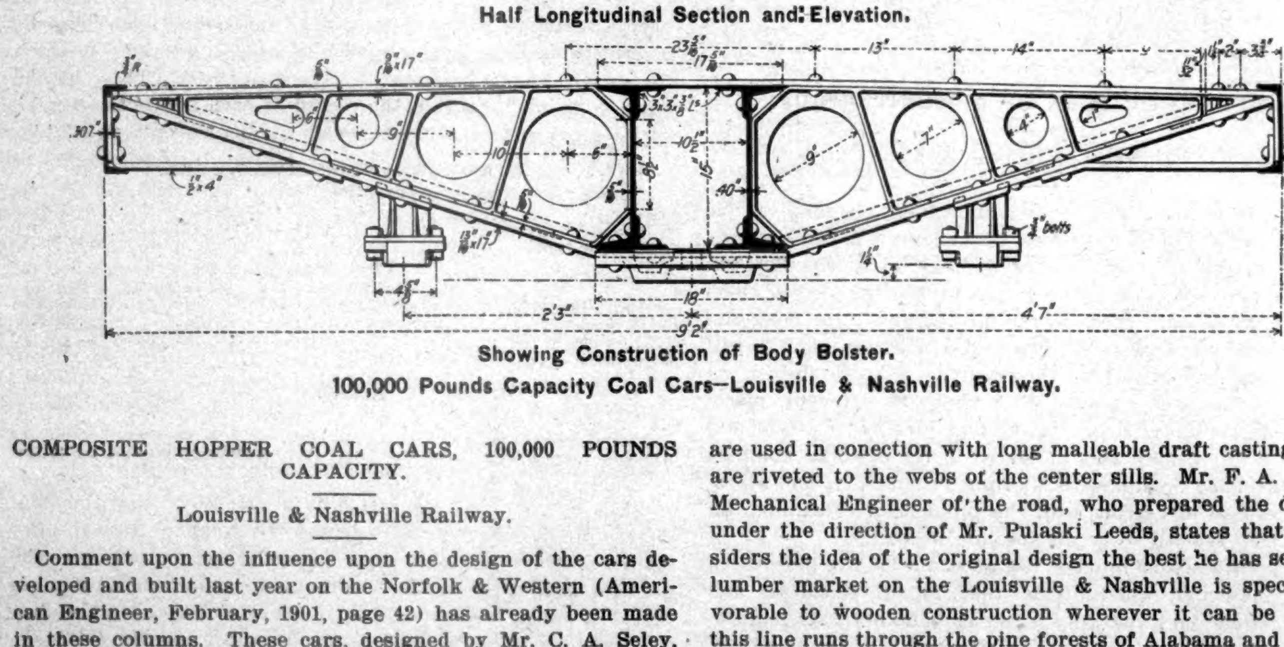
It is too soon to say what the results will be, but whether it is an ideal system or not it is a system from which eventually a large number of thoroughly trained young men are looked for. It seems fair to expect that it will produce a large number of good men who are thoroughly imbued with the traditions and spirit of the works. One of its prominent features is that by which the problem receives the exclusive attention of a man with a wide and successful experience.



Plan View Showing Under Framing.



Half Longitudinal Section and Elevation.



Showing Construction of Body Bolster.

100,000 Pounds Capacity Coal Cars—Louisville & Nashville Railway.

COMPOSITE HOPPER COAL CARS, 100,000 POUNDS CAPACITY.

Louisville & Nashville Railway.

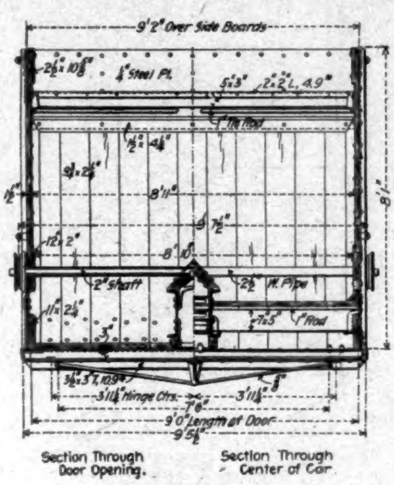
Comment upon the influence upon the design of the cars developed and built last year on the Norfolk & Western (American Engineer, February, 1901, page 42) has already been made in these columns. These cars, designed by Mr. C. A. Seley, under the direction of Mr. W. H. Lewis, have been very successful and in every way have fulfilled what was expected of them. They embody steel underframes and trussed side frames of steel, with wooden hoppers, and the sides are utilized in carrying the loads with the result of securing a paying load of 74 per cent., the light weight of one of the cars being but 38,000 lbs. It is decidedly pleasing to receive the drawings of cars of similar capacity now being built on similar lines by the Louisville & Nashville Railroad at Louisville. The idea of the framing was taken from our illustrations of the Norfolk & Western car already referred to, and it was adapted in minor details to the special requirements of the L. & N. The details of the draft rigging are new, the castings being of malleable iron, which are nowhere more than 5/16 in. thick. Tandem springs are used in conection with long malleable draft castings which are riveted to the webs of the center sills. Mr. F. A. Beckert, Mechanical Engineer of the road, who prepared the drawings under the direction of Mr. Pulaski Leeds, states that he considers the idea of the original design the best he has seen. The lumber market on the Louisville & Nashville is specially favorable to wooden construction wherever it can be used, as this line runs through the pine forests of Alabama and Georgia, and lumber is cheap with no transportation charges.

This car weighs 38,400 lbs., 400 lbs. more than that of the Norfolk & Western. Its cubical contents are 1,625 cu. ft. level full and 2,000 cu. ft. when heaped, which is about the same as the original design. This capacity is sufficient to provide for 110,000 lbs. of the lightest coal the cars will be called upon to carry.

In comparing the drawings of these two designs the use in both of 15-in. channels for center sills and 8-in. channels for side sills will be observed; also the channel sections and trusses of the side frames are alike, except as to small differences in the panel dimensions. The Louisville & Nashville car has T-iron corner posts and wide trussed doors, which are arranged in two sets with a small ridge between, instead of

having three sets of doors. Body bolsters of cars of this type must be strong, and in this detail also the construction of the Norfolk & Western has been followed. The body bolsters have 9/16 by 17-in. top members, 13/16 by 17-in. bottom members and malleable iron filling pieces extending the full length of the bolster from the center sills. The side sills are braced to the bottom members of the bolsters, as indicated in the drawings. It will be noted that the body side bearings are substantially supported by the malleable fillers. The general dimensions of the original design having been previously recorded, further description is not necessary.

In addition to 250 of these 50-ton cars this road is building 750 40-ton gondolas, weighing 34,800 lbs., and 100 40-ton flat cars weighing 28,000 lbs. For all of these cars the truck bolsters and spring planks are of cast steel. Parts of the trucks are alike for the 40 and 50-ton cars, except the axles, arch bars and bolsters, the trucks being the standard in use on this road.



Transverse Section.

HIGH-SPEED ELECTRIC CAR OF THE ALLGEMEINE ELECTRICITATS GESELLSCHAFT OF BERLIN.*

The car described in the paper is now finished, and, so far as trials and tests in the factory can give an indication of its behavior under working conditions, has answered all expectations. It was tested at a peripheral speed of the wheels of about 56 meters per second, corresponding to a car speed of 200 to 210 kilometers per hour.

The Studiengesellschaft was formed to study the technical and economical requirements of electric driving on long distance railroads. The maximum limit of speed for the trials determined upon was 200 km. an hour (124 miles). After careful consideration, it was decided to use an existing military line from Berlin to Zossen, placed by the German Military Department at the disposal of the Association. The paper relates to the construction and testing of the car, and to investigations and experiments in connection therewith. The running tests on the line will shortly commence.

The motors are attached to the car. Each car will accommodate about 50 passengers. The motors have in all a normal output of 1,000 horse-power, and a maximum output of 3,000 horse-power. The tests will show whether so much power is really necessary, and will indicate the consumption of power at different speeds, and under the influence of head or side winds.

For the working of long-distance railroads, the three-phase alternate current system could alone be considered. The generation and transmission of three-phase currents at from 40,000 to 50,000 volts pressure present no difficulty, but on the experimental line the pressure will be only 12,000 volts, the current being supplied from the central generating station of the Berlin Electricity Works, which is situated at a distance of 12½ km. from the commencement of the line. The length of the line is 24 km.

At present, transformers are placed on the car itself to transform the current down from 12,000 to 400 volts; but it is still undecided whether, in practice, it may not be better to use motors of medium voltage, say of 3,000 volts, taking the current at this pressure from the line, to which it is supplied through transformers placed in transformer houses at definite intervals along the track. In this case the transformers would reduce the pressure from 50,000 to 3,000 volts. It is well known that static transformers require no attendance as compared with rotary transformers.

The car is provided with a driver's platform at either end, from which the control is effected. All parts carrying current are placed in a special apparatus compartment, which is separated from the rest of the car by a double sheet-iron partition. The car body is carried by two bogies, each with three axles, of which the center is only a running axle, while each of the others carries a 250 horse-power motor, capable of developing a maximum of 750 horse-power. The diameter of the car wheels is 1,250 mm., and the speed about 960 r.p.m.

The weight of the electrical equipment was, in the first instance, not less than 50 tons for the required output of 3,000 horse-power, but, by modifying the construction of the starting apparatus, motors and transformers, the weight was reduced to 30 tons; but of this weight a large proportion was due to the transformers, which may possibly be dispensed with altogether hereafter.

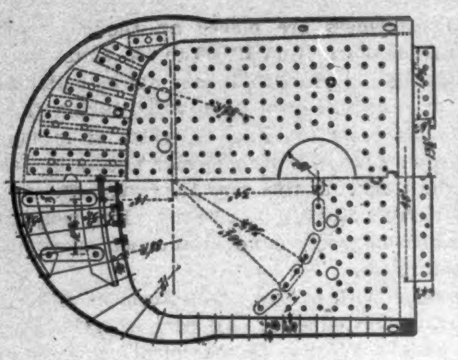
The mechanical connection between the motors and the axles of the wheels was a matter of the greatest importance, the use of intermediate gearing being out of the question on account of wear and tear. Although from the first the object was to obtain an elastic coupling, various designs and devices were tried, in some of which the motor was rigidly attached to the axle, while in others springs were introduced. The designing of a spring attachment for use at about 1,000 r.p.m., and with an output of 750 horse-power per motor, was a difficult task. The problem was solved by connecting the motor to the wheel by an elastic coupling, and providing an elastic suspension for the motor, the springs being arranged so as to have increasing rigidity as the load increases. The motors are accordingly mounted on a hollow shaft, of which the surface speed in the bearings is nearly 15 m. per second.

Starting resistances for motors of 250 to 750 horse-power have already been used in practice, but the problem of arranging them in a confined space, for use in continuous current regulation in connection with a current of 4 x 750 horse-power, has never before been contemplated. The relative advantages of liquid and metal resistances were considered in detail. The use of the former at first seemed out of the question, while the latter involved the employment of a large number of contacts, brushes, connecting cables and resistance material, making them too heavy and cumbersome.

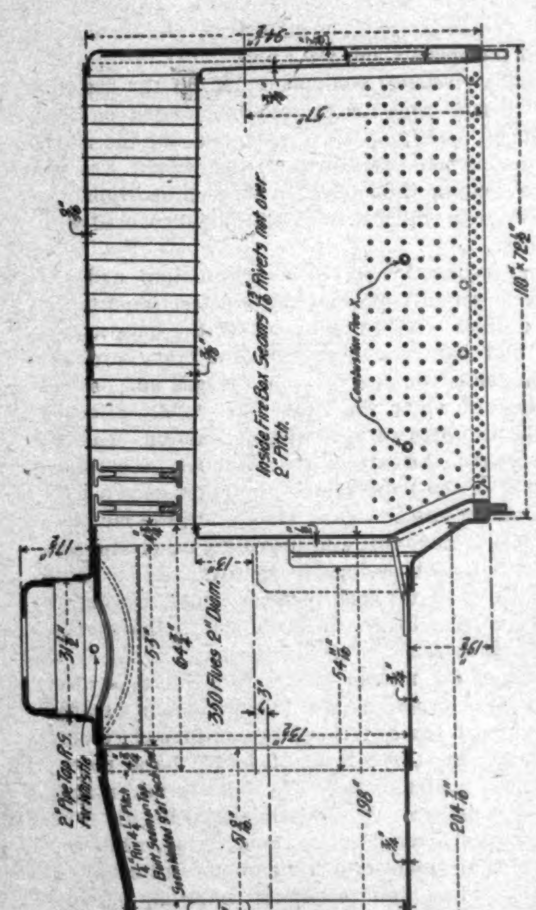
Four motors, each with three armature circuits, give a total of 12 phases, in each of which was inserted a resistance divided into 12 steps; but in spite of this sub-division, the regulation was found to be too jerky to be satisfactory. Ultimately a liquid starting device, that could be equally well used for large winding engines, was designed. The resistance material was a solution of soda, but the apparatus had nothing in common with the ordinary liquid starting resistance.

Taking into account the fact that a speed of 200 km. per hour was contemplated, it was arranged to provide, in addition to the Westinghouse air brake, an electrical brake which could be used either in connection with, or independently of, the source of current. The brake was so designed that it could be applied either gently or powerfully, at will.

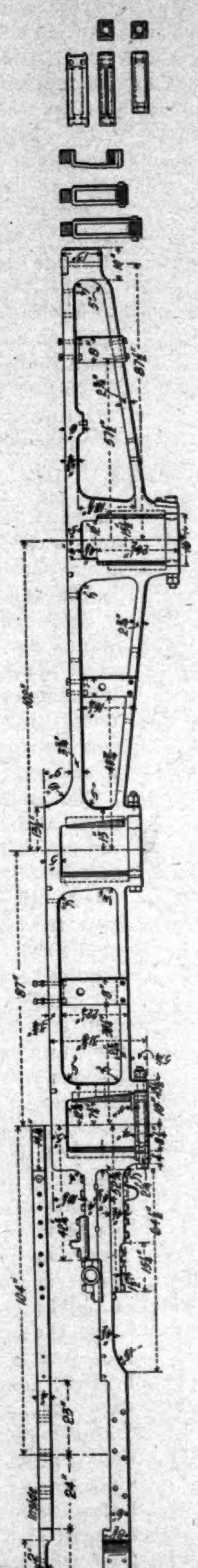
*From a paper by O. Lasche, read before the International Engineering Congress, Glasgow.



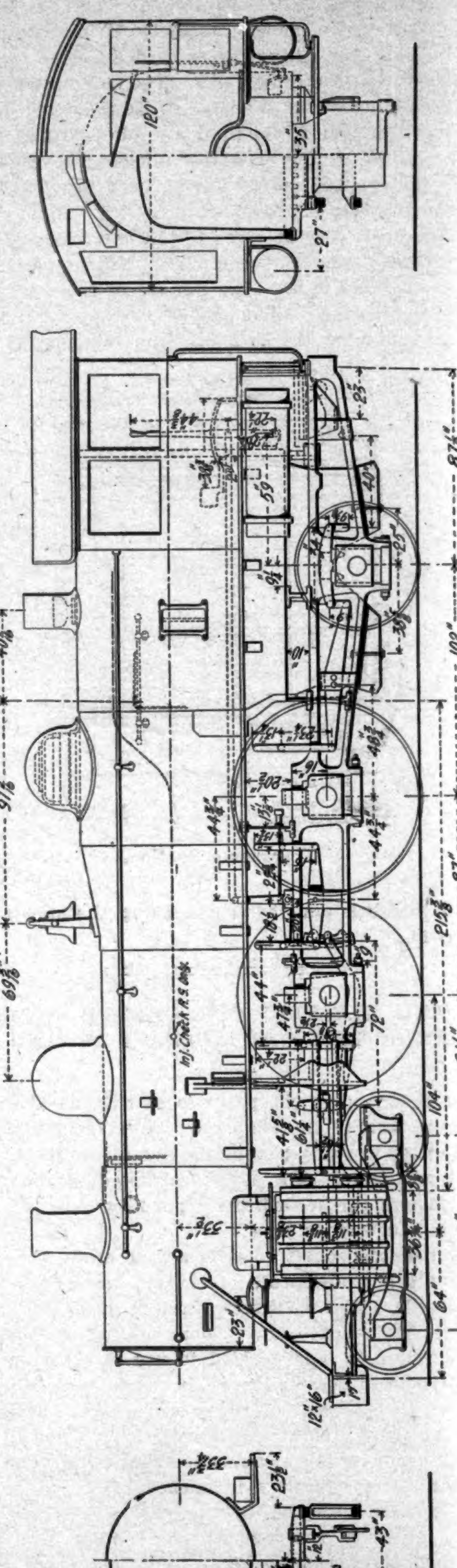
Transverse Section of Firebox.



Longitudinal Section of Boiler.



Side Elevation of Frames.



Side Elevation and End Sections.
Atlantic Type Passenger Locomotive—Chicago, Milwaukee & St. Paul Railway.
BALDWIN LOCOMOTIVE WORKS, *Builders*.
A. E. MANCHESTER, *Superintendent of Motive Power*.

VAUCLAIN CONSOLIDATION COMPOUND ATLANTIC TYPE PASSENGER LOCOMOTIVE—CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

A. E. MANCHESTER, *Superintendent Motive Power.* BALDWIN LOCOMOTIVE WORKS, *Builders.*

Cylinders: 15 and 25 by 28 in. Boiler pressure ......200 lbs.
Wheel: Driving......................84 in.; engine truck......................36 in.; trailers......................54 in.
tender wheels......................38 in.
Weights: Total of engine......................170,000 lbs.; on drivers......................90,000 lbs.; total engine and tender......................250,000 lbs.
Grate area and tubes: Grate area......................40 sq. ft. Tubes......................350-2 in. 16 ft. 6 in. long.
Firebox: Length......................8 ft. 6 in.; width....5 ft. 5 in. Depth in front......................70 in.; back......................64 in.
Boiler: type......................Wagon top, radial staying. Diameter......................66 in.
Heating surface: Tubes......................3,008 sq. ft.; firebox......................190 sq. ft.; total......................3,198 sq. ft.
Wheel base: Driving......................7 ft. 3 in.; total of engine........29 ft. 9 in.: engine and tender......................57 ft. 5½ in.
Tender: Eight-wheel; water capacity......................7,000 gals.; coal capacity......................9 tons.

For heavy passenger service the Chicago, Milwaukee & St. Paul has used Vauclain compounds of the Atlantic type for a number of years with marked success. Nine engines of the same type, with far greater power, are building at the Baldwin Locomotive Works. These are not far enough advanced to permit of showing a photograph, but the elevation drawing gives an excellent idea of their appearance. For comparison with the earlier engines the following figures are convenient and striking, because they indicate a large increase in capacity:

	No. 838.	New Class.
Heating surface	2,244 sq. ft.	3,198 sq. ft.
Total weight	140,700 lbs.	170,000 lbs.
Weight on drivers	71,600 lbs.	90,000 lbs.
Grate area	30 sq. ft.	40 sq. ft.
Cylinders	13 and 22 by 25 ins.	15 and 25 by 28 ins.
Drivers	78 ins.	84 ins.
Tubes, length	15 ft.	16 ft. 6 ins.
Boiler diameter	60 ins.	66 ins.
Tractive power	15,502 lbs.	20,400 lbs.

In weight on drivers, total weight, heating surface and grate area these engines are surpassed by the New York Central engines illustrated in our February issue, page 35, but the compound cylinders must be considered in comparing their power. With the increased heating surface and one-third larger grate area the boilers should be correspondingly more powerful than the earlier class on the St. Paul road, and excellent performance is expected. Without unduly lengthening the tubes, the large drivers have been accommodated by offsetting the front water leg of the firebox, as indicated in the elevation view. By forging the frames down behind the rear driving boxes the firebox is made 70 ins. deep in front and 64 ins. at the rear, with the mud ring level. We show the elevation and sections of the engine, longitudinal and cross-sections through the boiler, and a side elevation of the frames. The rear of the cab is made flush with the ends of the frames, and the back head of the boiler is vertical. Other details of the design are indicated in the following table:

General Dimensions.

Gauge	4 ft. 8½ ins.
Simple or compound	Compound
Fuel	Illinois soft coal
Weight on drivers	90,000 lbs.
Weight, total	170,000 lbs.
Weight, tender, loaded	120,000 lbs.
Note.—These weights are approximate.	
Wheel base, total of engine	27 ft. 11½ ins.
Wheel base, driving	7 ft. 3 ins.
Wheel base, total, engine and tender	57 ft. 5½ ins.
Length over all, engine	45 ft. 11 ins.
Length over all, total, engine and tender	68 ft. 7 ins.
Height, center of boiler above rails	9 ft. 5½ ins.
Height of stack above rails	14 ft. 11 ins.
Heating surface, firebox	190 sq. ft.
Heating surface, tubes	3,008 sq. ft.
Heating surface, total	3,198 sq. ft.
Grate area	40 sq. ft.

Cylinders.

Cylinders, diameter	15 ins. and 25 ins.
Piston stroke	28 ins.
Piston rod, diameter	3¾ ins.
Kind of piston rod packing	United States Metallic
Main rod, length center to center	11 ft. 4 ins.
Steam ports, length	Circular, 34 ins.
Steam ports, width	1½ ins.
Exhaust ports, length	Circular, 34 ins.
Exhaust ports, width	4½ ins.
Bridge, width	2¾ ins. and 3 ins.

Valves.

Valves, kind of	Balanced piston
Valves, greatest travel	5¼ ins.
Valves, outside lap	H. P., ¾ in.; L. P., ⅝ in.
Valves, inside clearance	H. P., ⅛ in.; L. P., ¼ in.
Valves, lead in full gear	H. P., 0 in.; L. P., ⅛ in.

Wheels and Journals.

Drivers, diameter	84 ins.
Drivers, material of centers	Cast steel
Truck wheels, diameter	36 ins.
Trailing wheels, diameter	54 ins.
Journals, driving axle, size	9 ins. by 12 ins.
Journals, truck axle, size	6 ins. by 10 ins.
Journals, traling axle, size	8½ ins. by 12 ins.
Main crank pin, size	6 ins. by 6½ ins.

Boiler.

Boiler, type of	Wagon top
Boiler, working steam pressure	200 lbs.
Boiler, material in barrel	Steel
Boiler, thickness of material in barrel	11/16 in. and ¾ in.
Boiler, diameter of barrel	66 ins.
Seams, kind of horizontal	Sextuple riveted
Seams, kind of circumferential	Double riveted
Thickness of tube sheets	½ in.
Thickness of crown sheet	⅜ in.
Crown sheet stayed with	Radial stay
Dome, diameter	31½ ins.
Tubes, number	350
Tubes, material	Iron
Tubes, outside diameter	2 ins.
Tubes, length over sheets	16 ft. 6 ins.

Firebox.

Firebox, length	8 ft. 6 ins.
Firebox, width	5 ft. 5⅛ ins.
Firebox, depth, front	70¼ ins.
Firebox, depth, back	64 ins.
Firebox, material	Steel
Firebox, thickness of sheets	5/16 in. and ⅜ in.
Firebox, brick arch	Yes
Firebox, water space, width	Front, 4 ins.; sides, 3 ins.; back, 3 ins.
Grate, kind of	Rocking and drop plate

Other Parts.

Exhaust nozzle	Double
Exhaust nozzle	Permanent
Exhaust nozzle, diameter	3¼ ins., 3½ ins., 3¾ ins.
Exhaust nozzle, distance of tip below center of boiler	2 ins.
Netting	Wire
Netting, size of mesh or perforation	3 ins. by 3 ins.
Stack	Straight
Stack, diameter	18 ins.
Stack, height above smoke box	2 ft. 8 ins.

Tender.

Type	8-wheel swivel trucks
Tank capacity for water	7,000 gals.
Coal capacity	9 tons
Kind of material in tank	Steel
Thickness of tank sheets	¼ in. and 5/16 in.
Type of underframe, wood or iron	Wood
Type of truck	Barber
Truck with swinging motion or rigid bolster	Rigid
Type of truck spring	Coil
Diameter of truck wheels	38 ins.
Diameter and length of axle journals	5 by 9 ins.
Distance between centers of journals	76 ins.
Diameter of wheel fit on axle	6⅜ ins.
Diameter of center of axle	5⅜ ins.
Type of truck bolster	Barber
Type of truck transom	Barber
Length of tender frame over bumpers	290 ins.
Length of tank	264 ins.
Width of tank	118 ins.
Height of tank, not including collar	73 ins.

The importance of good firing in considering methods of economical operation of power plants is not always as thoroughly appreciated as it ought to be. Mr. Abbott, of the Chicago Edison Company, recently, before the Western Society of Engineers, directed attention to this as follows: "There is, as most every one of us knows, a wide difference between what can be obtained in general practice and what can be obtained on tests. You may make a series of tests on a certain fuel and the results would point, say, toward the Promised Land, and on trying them later on, under ordinary conditions, unless you have the most careful management of the boiler house, you will find your results will then point in the opposite direction. I am becoming impressed more and more with the fact that the boiler room usually does not receive the attention to which it is entitled, and that instead of spending so much attention and providing the very best superintendent for the engine room, if these were divided between the engine room and the boiler room, the results which would be obtained in the latter place would far outweigh any possible improvement which might be made in the engine room. In ordinary boiler practice the efficiency of the boilers is probably not greater than 50 per cent. and as low as 40 per cent. Good practice, however, can bring this up to 70 per cent., and in some cases as high as 80 per cent. Now, there is that chance of a possible improvement of 30 per cent., or in some cases 50 per cent., which may be made by proper attention to the work of the boiler room."

EXTENSION OF THE SNOQUALMIE FALLS POWER COMPANY'S INSTALLATION.

Of all water-power plants in existence, this hydro-electric installation is probably the most interesting. During the last six months it has been visited by engineers and capitalists from all over the world, who speak in high praise of its correct design and the superior excellence of its mechanical operation; with a most varied service that includes electric traction, mill and factory power, as well as ordinary illumination, the entire load of the Snoqualmie system is operated in multiple, and with a regulation of less than 2 per cent. The development of this installation is largely due to the business sagacity of the company's president, Mr. Charles H. Baker.

Two years have passed since the first current from Snoqualmie Falls was carried into the cities of Seattle and Tacoma, Washington, and in this short time the initial installation has proven too small. The capacity of the plant is to be enlarged to meet the increasing demand for power in these growing western cities. At the Falls, distant 44 miles in an air line from Tacoma, and 32 miles from Seattle, are installed in a rock-excavated chamber four generating units, each consisting of a water wheel direct-connected to a 2,000-horse-power Westinghouse three-phase alternator. This power-transmission system, now generating and distributing 8,000 electrical horse-power, is to be more than doubled in capacity. At the same transmission voltage now employed, 30,000 volts, it is proposed to carry 12,000 horse-power more into the cities above mentioned, making a total output of 20,000 electrical horse-power. The electrical machinery is to be wholly furnished by the Westinghouse Electric & Manufacturing Company.

The Abner Doble Company, of San Francisco, which furnished the water-wheel equipment for the initial installation, are figuring upon placing their wheels in the new extension, and an engineer of another water-wheel concern is likewise looking into the matter. The water-wheel contract will not be let for 60 days yet. If an impact wheel is used there will be a single wheel on each end of each generator shaft, and each wheel will be driven by a single jet of water 14 ins. in diameter, the two jets combined being sufficient, under the existing head of 270 ft., to give the requisite power. The two water wheels, and the generator between, will be built on a single hollow shaft of oil-tempered nickel steel.

The present underground generating station, which is 200 ft. long, is to be lengthened out 150 ft. upstream to make room for the new installation. A new penstock is to be built, which will carry 50 per cent. more water than the old one. The transmission line, which is to parallel the old line, will require 125 tons of aluminum wire, and the order for it has already been placed. At Tacoma a large and commodious brick and stone sub-station is now being erected. The entire cost of these improvements will be in the neighborhood of $400,000. The work is to be vigorously prosecuted, and it is expected that the first of the new generators will be delivering current into Seattle and Tacoma within the next nine months. The generating machinery will consist of three 3,000-kw. (4,000 horse-power) rotating-field generators of the two-bearing type, generating a three-phase current at 1,100 volts and 7,200 alternations. The speed is to be 100 r. p. m. Each generator will require an exciting current of 320 amperes approximately, at 125 volts. For exciting these three generators a 200-kilowatt, eight-pole, direct-current generator of the two-bearing type is to be used. At 175 r. p. m. it is to deliver, under normal load, a current of 1,600 amperes at 125 volts.

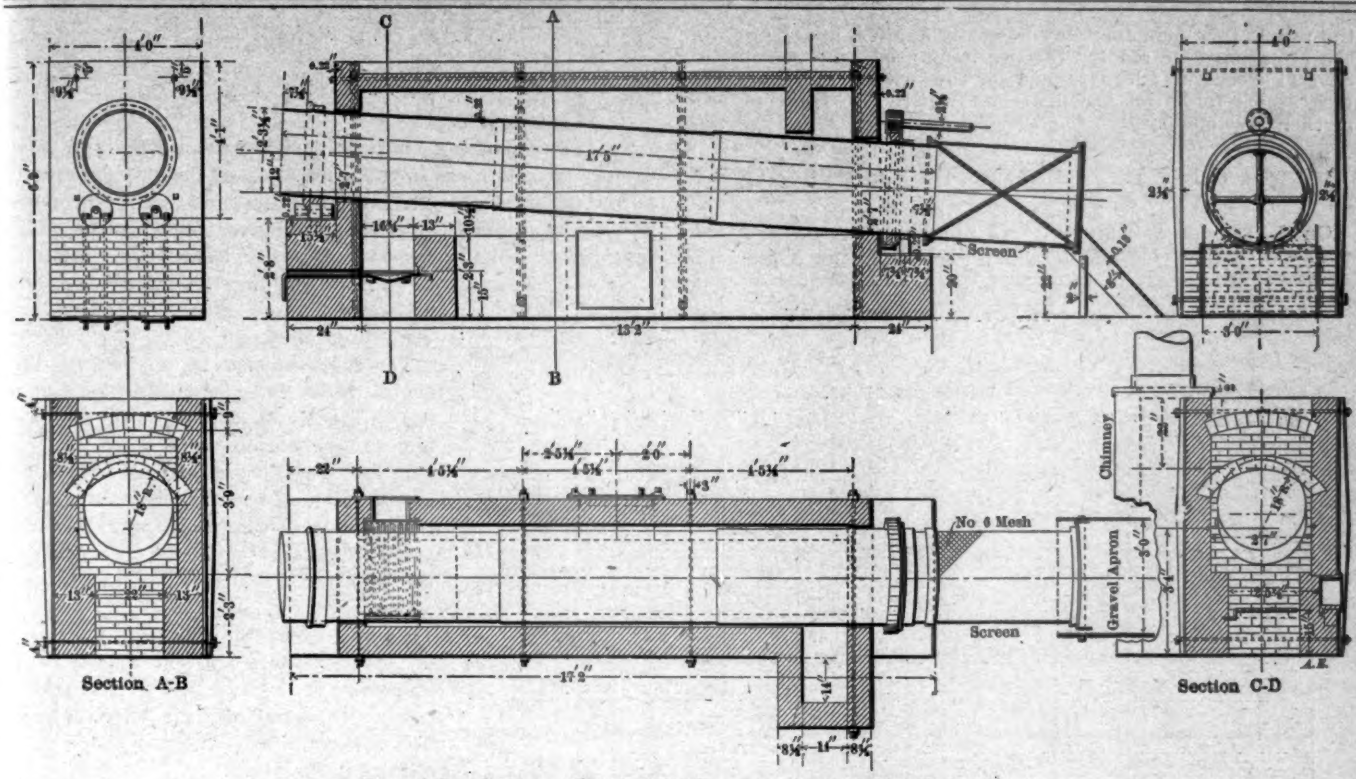
The current which is generated at 1,100 volts is to be raised to a line potential of 30,000 volts by nine 1,000-kilowatt, oil-insulated, water-cooled transformers. These are to be delta-connected on both the primary and secondary sides. It is estimated that each transformer will weigh 11,000 lbs. and require 500 gals. of oil. The switchboard to be installed is to consist of 14 panels of white marble, and is to be of the special type furnished for the original installation. Instead of the Niagara-type single-phase indicating wattmeter in use on the present switchboard, a polyphase long-scale indicating wattmeter is to be used. Where formerly a field-plug switch was used, a double-pole field switch is to be employed. The standard equipment of synchronizing lamps is to be replaced by a single-pole plug switch mounted on the generating panel and connected to a synchroscope, which will be mounted on the multiplying panel. The increased capacity of the generators will necessitate placing three single-pole main switches instead of one three-pole main switch. The circuit-breakers, which are to be non-automatic, will be placed on an extension panel, above the main instrument panel.

The metric system.—Consul Haynes, of Rouen, under date of August 26, 1901, says that the metric system is to-day compulsory in twenty countries, representing more than 300,000,000 inhabitants—Germany, Austria-Hungary, Belgium, Spain, France, Greece, Italy, Netherlands, Portugal, Roumania, Servia, Norway, Sweden, Switzerland, Argentine Republic, Brazil, Chile, Mexico, Peru and Venezuela—and advises American exporters in dealing with any of these countries to adopt the system.

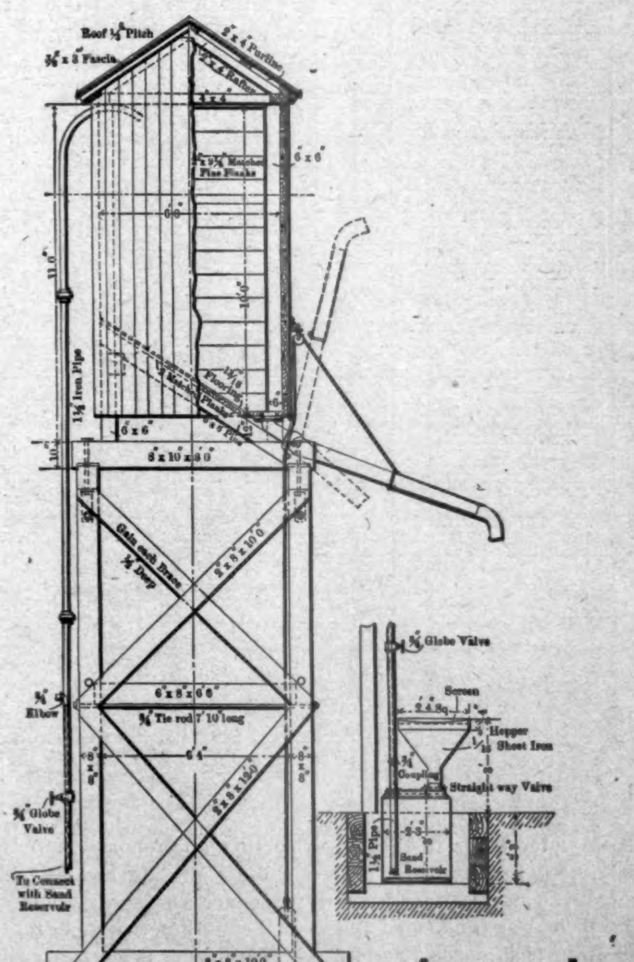
Racing automobiles have been developed in Europe to an astonishing degree, which suggests possibilities concerning the application of internal combustion motors to heavier and more important services. These machines are valueless except for racing, but the facts that in the recent Paris to Bordeaux race the winner made a schedule of 53¼ miles per hour and that the same machine later ran from Paris to Berlin, 744 miles, at an average speed of 46½ miles per hour, is most impressive as an illustration of what may be done on a rough road. The machines had 50 h.p. motors, and the speed is stated by "The Engineer" to have been as high as 70 and 75 miles per hour in places. A record of 744 miles in the net time of 16 hours 6 minutes would be very creditable for a locomotive on the best of track. The success of this race, although 110 started out of 170 machines entered, and but 45 finished, places the internal combustion motor in a favorable light after a development of but five years in this direction. Perhaps its possibilities have not yet been exhausted.

The Traveling Engineers' Association held its annual convention in Philadelphia, September 10. In discussing the subject of methods of firing locomotives, the Bates fire-door, with a narrow slit about 5 by 17 ins. in size, was strongly endorsed. This door required frequent and light firing, and the air admitted above the fire through the opening, which was never closed, seemed to have a beneficial effect on the fire. In the discussion of the subject of the relative merits of grease and oil for lubricating locomotive crank pins, it appeared that the tendency toward careless maintenance of engines under the pooling system gave the advantage to grease, which worked better than oil under unsatisfactory conditions in the rod cups. Several arguments were presented in favor of oil and better maintenance of oil cups, which would render the use of oil entirely satisfactory. The association also took up the subject of locomotive light and emphasized the importance of better attention to headlights and signal lamps than they generally received under the pooling system.

The transportation problem in Boston is a most difficult one on account of the narrow and crooked streets. On the 10.7 miles of track now operated by the Boston Elevated Railway there are 3,395 degrees of curvatures which if laid out from a common center would double on itself over nine times. The longest stretch of straight track is less than .28 of a mile. The ascending grades are as high as 5 per cent., or 264 ft. per mile, and the descending grades as high as 422 ft. per mile, or 8 per cent. In addition to the present 10.7 miles of track, of which 2.27 miles is underground in the subway and the remainder on elevated structures at each end of the road, there is nearing completion the Atlantic avenue division, having 4.69 miles of track. This will supplement the subway portion.



Rotary Sand Dryer—Chicago, Milwaukee & St. Paul Railway.



Sand Chute and Elevator.

IMPROVED SAND DRYER AND BIN FOR LOCOMOTIVE SAND.

Chicago, Milwaukee & St. Paul Railway.

An indication of increased efforts to improve facilities for promptly dealing with locomotives at roundhouse terminals is seen in the interest which is now taken in methods of supplying an abundance of dry sand for locomotive sand boxes. The day of the old cast-iron stove which must be fed with a shovel is past on many roads, and through the kindness of Mr. A. E. Manchester, Superintendent of Motive Power, and Mr. R. R. Bradley, Mechanical Engineer of the Chicago, Milwaukee & St. Paul Railway we have received drawings of the new rotary sand dryer recently put into service on that road.

There seems to be a tendency toward the use of hotter surfaces for drying sand than can be had with steam pipes, because of the desire for quicker and more thorough drying. Steam pipes seem to work very well with crushed stone, such as the Pennsylvania road uses, but the general use of the pneumatic sander seems to require something better.

This rotary dryer was intended for a capacity of about 10 or 12 cu. yds. in 10 hours, but it has proved to be a little slower than that and the grate area will probably be increased, otherwise the device is entirely satisfactory. The dryer is a cylinder 27½ ins. in diameter and 17 ft. 5 ins. long with open ends and supported in a brick setting on rollers at an angle with the horizontal. Its operation and the arrangement of the screen at the delivering end are seen at a glance. At the ends of the cylinder, rings made of old 33-in. tires are secured, the upper one having the flange to hold the cylinder in position, while the lower one forms the attachment of the driving gear. In the inside of the cylinder angle irons are riveted in spiral form, giving about 1½ turns in the length of the barrel. These agitate the sand and also delay its movement down the cylinder. Sand is shoveled into the high end, or it may later be delivered by an automatic conveyor. It gradually works down as the cylinder revolves and falls into a hopper placed under the screen, from which it is raised to the chutes by compressed air. Large lumps, stones or other undesirable matter passes out of the end of the screen into a wheelbarrow. When the hopper is full the valve is opened and the sand allowed to fall into the cylindrical tank shown in the other drawing. From here it is elevated into the bin by air pressure from the small pipe.

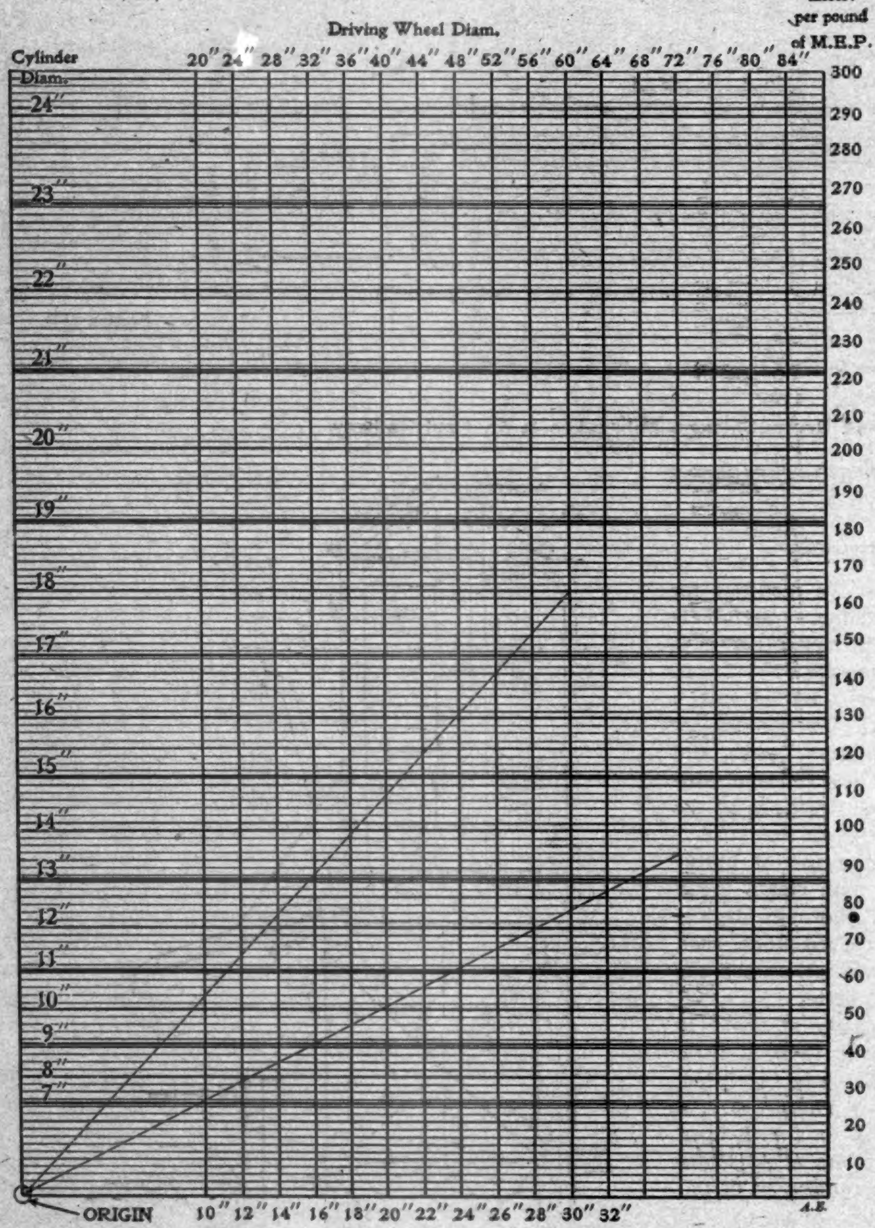
It is obvious that this dryer may be developed still further and its capacity greatly increased if necessary. For example

the return tube principle may be easily applied, and except for the attention required for the fire it may be made automatic. Several speeds may be arranged for the rotating cylinder. The idea seems to be an excellent one which is capable of still further development.

WATER TUBES IN FIREBOXES, ENGLISH PRACTICE.

On the London & South Western Railway Mr. D. Drummond, Locomotive Superintendent, about two years ago applied inclined water tubes to the upper portion of fireboxes, and the experiment has apparently been successful. He has just repeated the application to new passenger engines. This arrangement was illustrated and described in our issues of March and July, 1899, pages 79 and 223. These tubes are arranged in two nests inclined in opposite directions, the staying being done by rods passing through a number of the tubes. About 215 sq. ft. of most valuable heating surface is secured in this way. In our illustrated description of this device it was shown that if applied to the Great Northern locomotive (American Engineer, October, 1898, page 328), about 350 sq. ft. of firebox heating surface could be provided by means of such tubes.

TRACTIVE POWER CHART



STROKE

A TRACTIVE POWER CHART.

By Lawford H. Fry.

The accompanying chart is designed as a time and labor-saving device for use in the calculation of the cylinder tractive power of a locomotive. Other charts and tables have been prepared for this purpose, but the present one has the advantage that it can be reproduced at any time with a minimum of calculation, and the tractive power of odd-sized cylinders can be readily found by interpolation.

The chart consists of vertical and horizontal lines. The vertical lines end at the top in a scale of driving wheel diameters and at the bottom in a scale of stroke lengths. The horizontal lines are in two series, the one terminating at the left of the chart in a scale of cylinder diameters, while the other series of lines ends on the right of the chart in the tractive power scale.

Having given the diameter and stroke of the cylinders and the driving wheel diameter of a locomotive, its tractive power per pound of mean effective pressure is determined from the chart by the following operation:

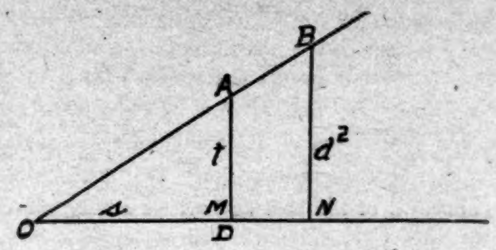
Pick out the lines corresponding to the given diameters of cylinders and driving wheels and follow them to their intersection. Through this point draw a diagonal line passing also through the "Origin" at the lower left-hand corner of the chart. Find the intersection of this diagonal with the vertical line corresponding to the length of stroke. The horizontal line through this point of intersection is marked on the right-hand scale with the tractive power required.

For example, to find the tractive power of a locomotive having cylinders 18 by 26 ins. and driving wheels 60 ins. in diameter. Find the intersection of the lines for 18-in. cylinder diameter and 60-in. driving wheel diameter and draw a diagonal line as shown in the figure through this point of intersection and the origin. Note the point of intersection of this diagonal with the vertical line marked 26 ins. on the length of stroke scale. This intersection is on a horizontal line marked 140 on the tractive power scale at the right of the chart. The consequent conclusion is that a locomotive of the above dimensions will develop a cylinder tractive power of 140 lbs. per pound of mean effective pressure.

As another example, which also illustrates the application of the chart to odd-sized cylinders, take the case of the high-pressure cylinders of a four-cylinder compound engine, say, 13½ by 26 ins. with 72-in. drivers. Take a point on the 72-in. driving wheel line midway between the lines for 13-in. and 14-in. cylinder diameter, and through this point draw the diagonal to the origin. Find the intersection of the diagonal with the 26-in. stroke line and follow the horizontal through this intersection to the right-hand scale. The resultant reading is 66, which is the tractive power developed by the high-pressure cylinders per pound of mean effective pressure.

In using the chart it should be noticed that the tendency is to take the intersection of the lines for cylinder diameter and

stroke as the starting point. This is wrong. The diagonal from the origin must pass through the intersection of the two diameter lines (diameter of cylinders and diameter of drivers).



The reason for this will be evident from the following explanation of the principle of the chart:

If t = tractive power per pound of M. E. P.,
d = diameter of cylinder,
s = stroke of cylinder,
and D = diameter of driving wheels,

we have $$t = \frac{d^2 s}{D} \qquad (1)$$

hence $$\frac{t}{s} = \frac{d^2}{D} \qquad (2)$$

Now, in two similar triangles, as O M A and O N B, obviously

$$\frac{BN}{ON} = \frac{AM}{OM} \qquad (3)$$

Consequently if the triangles be so chosen that
B N is proportional to d^2,
O N is proportional to D,
and O M is proportional to s,

it follows from (2) and (3) that A M must be proportional to t. The chart is constructed on this principle. The vertical wheel diameter lines are drawn so that the horizontal distance from the left of the chart is proportional to the wheel diameter represented, and the cylinder diameter lines are drawn horizontally so that the distance of each from the lower base line is proportional to the square of the cylinder diameter represented. Then the stroke lines are put in. It is found convenient to use the same lines as for the wheel diameters, using a scale twice the previous one. The tractive power scale is determined by the foregoing and must be twice the scale used for the cylinder diameter. It is thus seen that the only calculation required in the construction of the chart is the determination of the values of d^2, and with a table of squares at hand even this can be avoided.

A correspondent of the Boston Herald calls attention to the fact that the 2-ft. gauge railroads in the State of Maine now aggregate a length of 156 miles. There are seven companies: The Sandy River, Farmington to Phillips, 18 miles; Bridgton & Saco River, connecting Harrison with Hiram, 21 miles; Phillips & Rangeley, connecting the towns thus named, 29 miles; Franklin & Megantic, from Strong to Bigelow, 31 miles; Wiscasset & Quebec, connecting Wiscasset and Albion, 44 miles; Kennebec Central, connecting Randolph and Togus, 5 miles; Monson, from Monson to Monson Junction, 8 miles. These roads own 22 locomotives, 23 passenger cars and 324 baggage, freight and miscellaneous cars. It is said that charters have been granted to several other companies which intend to build railroads of this gauge. The officers of the Bridgton & Saco River say that they have inquiries from all over the United States, as well as from Europe and the West Indies, asking about their experience with the narrow gauge; and lately a party of investigators from New Orleans, Central America and South America visited Maine to inspect the railroad. The standard locomotive on the Bridgton & Saco River weighs 13 tons.

WHAT WATER SOFTENING WILL DO.

Mr. J. Kruttschnitt, Vice-President and General Manager of the Southern Pacific, in his article in our June number said: "The far-reaching effects of bad water would lead me to place its improvement by chemical treatment as first in importance of the problem that confront motive power officers of the present day."

There is at present an encouraging tendency toward the belief that the locomotive boiler is sufficiently taxed with its legitimate offices without also burdening it with the additional duty of clearing its own water of corrosive and scale forming ingredients. This is seen in the more general acceptance of the theory that the worst waters should be prepared for locomotive use by preliminary treatment before going into the boiler and a large increase in the number of plants for this purpose may be expected. Such convincing testimony of the value of these plants as was given by Mr. Henry Miller, Assistant Superintendent of the Burlington Route, before the St. Louis Railway Club, is worthy of attention by all who are troubled with bad locomotive feed water. Mr. Miller gave an account of two locomotives of ordinary standard construction used daily between Hannibal and Burlington. He said:

"These engines ran 12,000 miles each during the month of May of this year and are now doing the work in which four engines were formerly employed. They are kept in almost continuous service without being cooled down, are washed out only twice a month, after making over 6,000 miles, which is extraordinary, and this seems to be very near the ideal condition for engine service.

"This performance was made possible by the discovery that at a regular water station our engines were being supplied with a fine quality of water produced by a new process of filtration. (The speaker probably meant softening.—Editor.) By equipping these engines with large tanks, they were enabled to perform the service required by taking most of their water at the station above mentioned, and at one other place where the water is fair. These engines are giving almost perfect service, there is no flue trouble, foaming or other difficulty present, and the plan thus far has proven entirely successful. It has also enabled a good showing to be made in passenger mileage on the St. Louis, Keokuk & Northwestern road because in one month nearly 72,000 passenger miles were made by seven engines, averaging 10,271 miles each; therefore the importance of good water at a single station is exemplified.

"At another place on the same division, a switch engine is located, which used to go to the shop once a week for washing out, involving a 38-mile run. We found we were getting good water there, and inquiry of the boiler washer as to how much solid matter developed in washing the boiler brought the response that there was very little. This showed that we were simply going through the motions of washing out when there was no real necessity for it. The method was changed at once, and the engine now goes to the shops only once every month or six weeks, when other work is necessary."

The remarkable record of an indicated horse-power hour obtained from an expenditure of 0.88 lb. of cheap bituminous slack coal was recently obtained from producer gas in a 600 h.p. Premier gas engine. These trials were conducted by Mr. Herbert A. Humphrey, London, and the details presented in a recent paper entitled "Power Gas and Large Gas Engines," by Mr. Humphrey before the Institute of Mechanical Engineers. These results establish a new world's record for thermal efficiency attained with producer gas. The coal used was of poor quality, containing only 62 per cent. of carbon. There was no way at the time of the tests of absorbing the full power of the engine, but the author feels justified in saying that a thermal efficiency of not less than 27 per cent. would have been reached when running in regular working under full load.

(Established 1832.)

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
J. S. BONSALL, Business Manager.
MORSE BUILDING..NEW YORK

G. M. BASFORD, Editor.
E. E. SILK, Associate Editor.

OCTOBER, 1901.

Subscription.—$2.00 *a year for the United States and Canada;* $2.50 *a year to Foreign Countries embraced in the Universal Postal Union.*
Remit by Express Money Order, Draft or Post Office Order.
Subscriptions for this paper will be received and copies kept for sale by the
Post Office News Co., 217 Dearborn St., Chicago, Ill.
Damrell & Upham, 283 Washington St., Boston, Mass.
Philip Roeder, 307 North Fourth St., St. Louis, Mo.
R. S. Davis & Co., 346 Fifth Ave., Pittsburg, Pa.
Century News Co., 6 Third St. S., Minneapolis, Minn.
Sampson Low, Marston & Co., Limited, St. Dunstan's House, Fetter Lane, E. C., London, England.

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Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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AMERICAN ENGINEER TESTS.

Locomotive Draft Appliances.

Preparations for the extensive series of tests on locomotive draft appliances which Professor Goss, of Purdue University, has been engaged to conduct for the American Engineer and Railroad Journal are sufficiently advanced to justify the publication of the preliminary investigation of what we know and what we want to know upon this subject, the first instalment of which is to be found in this issue.

In an undertaking of this character it is most important to make use of all existing information and to supplement it with investigations which will permit of applying to the greatest possible extent that which is already known, as well as that which is now sought for, to the conditions of locomotive practice as they exist to-day. To this end a careful analysis of the Von Borries-Troske tests and those of the Master Mechanics' Association of 1896 has been made by Mr. Vaughan. This has been reported upon by Professor Goss, and when brought before a voluntarily self-appointed committee of prominent motive power officers a general plan of procedure was selected. In accordance with this plan Professor Goss is now working, and the programme is such as to warrant the expectation of valuable results from each step in the general plan.

As the tests are to be conducted on a working locomotive and in accordance with actual conditions of practice a large amount of special apparatus will be necessary, for which the drawings have been prepared by Professor Goss, and the tests will begin at the opening of the Purdue University laboratories for the fall term.

It is our confident intention that these tests shall decide the question of "front end" construction, and solve the problem of the form and adjustment of draft appliances as applied to the large locomotives of the present time. The plan is well founded, with the approval of the best authorities among motive power officers, its execution is intrusted to Professor Goss, than whom there is no more careful and intelligent investigator and observer, and with the advisory co-operation of these railroad officials a valuable contribution to the science of the locomotive may be promised.

To the railroads it means a great saving in expenditures for fuel; to those who secure the records through our columns it will mean a relief from difficulties in working blindly; to the locomotive it may mean an increase of power without increasing weight, and to us it is a source of satisfaction in an effort to contribute to the information on so important a subject.

We invite the criticism and counsel of all who read the record.

WEIGHT AND POWER IN LOCOMOTIVES.

The strides made by the locomotive in the past five years in the direction of increased capacity have been most remarkable and these have led to improvements in operation which are without precedent. If the limits in size and weight have not been reached in some of the magnificent productions of this time, the margins are becoming narrow and many already look askance at the big engines which are now required. But the improvements in operation to which these monsters contribute reveal the necessity for something which is likely to be the most important influence in the future of this branch of engineering. The time has come for the most careful consideration of "means whereby the fireman will be enabled to shovel the maximum horse-power through the fire-door." This is not for the benefit of the fireman, though he needs some consideration, but in order to secure the utmost power within the ultimate limits of size and weight. In other words, this is a time to build locomotives in which every pound of weight will contribute the utmost possibility in power. The complications of machinery and increased cost of repairs will not stand in the way of this movement if these are necessary accompaniments. This leads to a consideration of what appears to be the most promising direction for development and in the following review editorial opinions are carefully avoided. There arguments have been presented to us from five different sources, by prominent motive-power officers in as many different parts of the country. They reflect the opinion that the four-cylinder balanced compound offers advantages sufficient to warrant a thorough trial in this country, and we present these views, confident that they are worthy of thoughtful study.

THE FOUR-CYLINDER BALANCED COMPOUND.

The compound principle has established itself securely on a basis of economy in steam. Opinions differ as to the cost of repairs, but those who are best qualified to judge believe the compound to be as cheap in maintenance as the simple engine, and others believe that if not so now this may be accomplished by further experience. However, the difference in cost of repairs is evidently less than the improvement in fuel consumption. But the matter of power is to be the chief consid-

eration, and for a given weight the compound certainly offers greater possibilities than the simple. There is no hazard in expressing the belief that the locomotive of the future must be a compound.

The two-cylinder type has made good records here and abroad. It has established itself firmly and is making friends. With two cylinders, however, the limit of size has already been reached, and this seems to indicate that another type must be selected for more powerful machines. Three cylinders have been used successfully, but for many reasons a better type seems to be available using four cylinders. In fact, the four-cylinder compound has undoubtedly the advantage over all other types, and it is in this direction that most is to be expected. Four cylinders are not popular, undoubtedly, and many would use but one cylinder in a locomotive if they could possibly get along with one. We are not now facing a question of desire, but of necessity. The large number of Vauclain engines and the recent ready acceptance of tandems have prepared the way for four-cylinder types, and they have shown that the advantage of the larger number of cylinders outweigh the objections to a larger number of parts. They have prepared the way for something with greater possibilities than either. These are steps in advance, but because they do not improve the situation with regard to reciprocating weight they are not believed to constitute the ultimate possibilities of the locomotive. To them, however, a great debt is due for convincing testimony as to the value of and necessity for four cylinders.

When the heaviest possible locomotives of prevailing types have been built, and this, perhaps, has not yet been done, the question of "what next" will arise. A four-cylinder design may be taken as a basis. If the question of counterbalancing the reciprocating parts is disposed of by a balanced engine with a crank axle and cylinders arranged in a row or after the de Glehn type, a large amount of additional weight may be placed on the drivers without increasing the damage to the track. For this reason this type of construction is believed to offer the greatest promise of the future, and within a short time this idea is expected to find ready acceptance among those who are now anxious as to how they may meet the demands for capacity.

With reference to clearances the type of construction under discussion is very favorable and there are other advantages which do not appear to be generally appreciated. One of these is the division of the steam into relatively small portions, not so much steam having to pass through any one of the ports as must pass through one of the ports of a simple engine. This means that there will be less loss of power from friction of steam, wire-drawing and back pressure. With longer cut-offs the four-cylinder compound will use the valve motion more favorably and secure larger port openings at high speeds. With more impulses in each revolution the stresses in the rods and frames will be reduced, and while there are more parts the load on each will be lighter and the parts may be made correspondingly light. With a balanced arrangement of the reciprocating parts the weight on drivers may be increased without damaging the tracks. This was mentioned before as a leading advantage. In accelerating trains there is no doubt that the French four-cylinder compounds excel all other locomotives and this attribute should be added to the others.

Increased complication and the crank axle constitute the chief disadvantages. Both of these are important, but they are likely to be found less objectionable in practice than in contemplation. It may not be necessary to come to this type of locomotive immediately, but it is believed to be the next step in progress, and much credit will come to him who has the courage to undertake a design which shall include these possibilities and yet conform to the greatest possible extent to American ideas of simplicity. It may interest our readers to know that drawings have been sent us in which the four-cylinder balanced principle has been worked out for a heavy six-coupled passenger engine and an eight-coupled freight engine of two of the leading railroads, both of these locomotives having been thoroughly illustrated in this journal. This was done to show the possibilities of application to three and four axles and to indicate a method of using present valve motion.

Who will take up in a practical experiment this attractive problem?

Never before has such prominence been given to the necessity for the proper maintenance of air-brake apparatus. It is perhaps natural for busy men to overlook important matters of this character until their attention is directed to them, and because the air brake has been such a faithful servant rather too much has been expected of it, but systematic and thorough attention is now imperative. We believe this fact is appreciated, and the inauguration of equipment and systematic methods of overhauling and repair will doubtless be noticed on every side. There is an evident desire to introduce the reform without waiting for the compulsion of disaster. The Master Car Builders' Association will doubtless be a factor in this movement.

SYSTEMATIC TREATMENT OF THE APPRENTICESHIP PROBLEM.

With about 90 per cent. piece work on a contract basis, the Baldwin Locomotive Works find it necessary to provide a systematic plan for dealing with the apprentice problem. The reasons why the old methods of apprenticeship no longer meet present needs are well understood, and in order to create a supply of well qualified young men, the management of these works inaugurated a systematic plan last February. It has worked very well thus far and seems promising.

Because boys in a piece-work shop can make better wages, as compared with apprentices' pay, and because the employer can get almost as much from a boy as from a man there is a tendency for boys to learn but one operation and neglect to secure an all-around apprentice training. This is bad for the boy and for the employer. If work in his particular line is slack and he afterward loses his position, he must work as a laborer or learn some new specialty. Piece work is profitable to the employer, but it has the serious disadvantage of cutting off the supply of thoroughly trained mechanics of the old school. It limits the resources of the employee and cuts off the source of supply of the best men.

This firm realized this, and also saw the need of providing at the same time the training in practical experience of the technical school graduate. At the start Mr. N. W. Sample, who, for years was at the head of the motive power department of the Denver & Rio Grande, was placed in charge of the problem as Superintendent of Apprentices, and the system which was worked out merits the careful attention of railroad men as well as manufacturers. It possesses features which appear to be specially adapted to railroads, one of which is to put the technical school graduate on a good basis, one that is fair to him, profitable to the employer and, what is perhaps even more important, does not discourage the regular apprentice. This last qualification is stated thoughtfully, because from this class of apprentices of the past the railroads owe some of their best motive power officers of to-day. With the usual special apprentice arrangement, the regular apprentice is discouraged. He sees special advantages offered to the educated boys and he feels sure that they will be selected instead of himself for promotion. This feeling extends also to the older men of the shop and it is believed to be a serious matter.

It is to be expected that the educated boy will be the more valuable, but is it wise and right that it should be taken for granted that this is a fact? Should not the boys prove it themselves? In other words, there should be a time in the career of both kinds of apprentices when they are offered equal oppor-

tunities, provided the regular apprentice has studied and acquired an education during his shop training. This the Baldwin plan provides. It does more, it obliges the regular apprentice to study, and if he desires he may do more than is required, and by special effort may put himself on the plane of his more favored rival. Whether he does so or not is not as important as that he should have the opportunity. To this feature of this system special attention is called, for it is usually considered unimportant to safeguard the regular apprentice. At these works all apprentices, at the termination of their time, stand equally on their merits. They are hired for further service if needed, and are hired on the basis of their worth. While the special apprentice has the advantage in education the others have an undoubted advantage in thoroughness in the shop, because of their longer contact with it.

It is fair and right and wise to treat the graduate as a trained thinker. He can acquire the shop training more quickly than the other. On the other hand, the regular apprentice is more likely to secure more thorough shop contact. The only advantage offered by the Baldwin plan to the special apprentice is the two years saving of time. In practice it seems to have a good effect upon both classes, whereas it must be admitted that the usual plan has not always produced the results expected or desired.

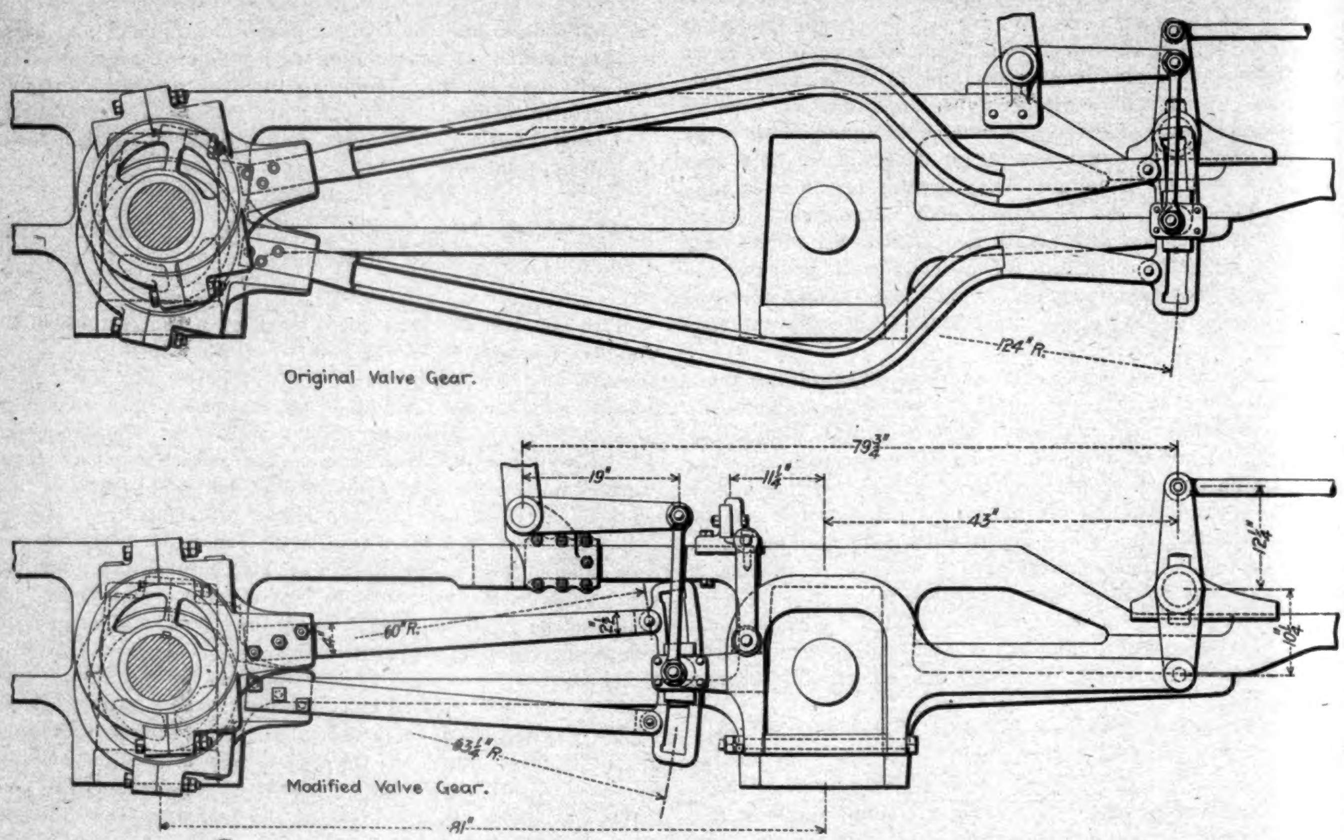
A study of this subject must lead to the conclusion that those who are in position to inaugurate a thorough system of recruiting the ranks of well-trained young men and are not doing so are missing an important opportunity, and failing in a real duty.

An exceedingly impressive and unprecedented tribute was paid to the memory of President McKinley on the afternoon of September 19, the day of the funeral service, by the cessation of all railroad and steamboat traffic in New York, Baltimore and Pittsburgh. By special orders, the street railroad and steamboat lines stopped traffic for five minutes during the time of the funeral service at Canton.

IMPROVEMENT OF VALVE GEARS BY USE OF THE INDICATOR.

Plant System of Railways.

Springy valve gears, improperly balanced valves and inadequate steam and exhaust passages are now thoroughly understood in their bad effects upon the distribution of steam in locomotives, particularly in their influence in cutting down the power and in making engines "logy," but such an extreme example as this which is furnished through the kindness of Mr. W. E. Symons, Superintendent Motive Power of the Plant System of Railways, is, fortunately, seldom seen. Mr. Symons is a thorough believer in the generous use of the indicator and such a discovery as this justifies the opinion that this little instrument offers opportunities for usefulness in the study of valve motions which are not less important than those relating to performance tests.

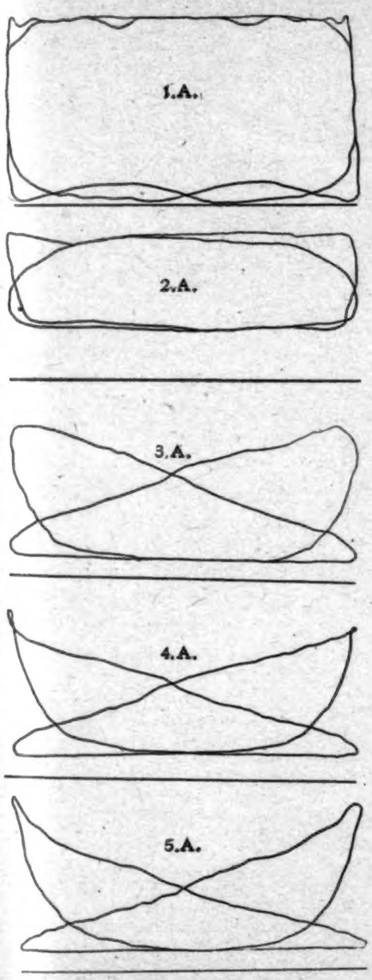


Comparison of Original and Improved Valve Gear.

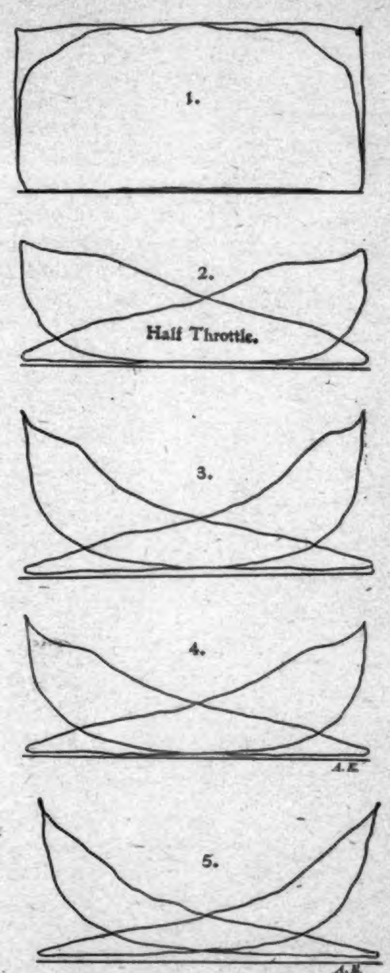
Some time ago in an unusual rush of business Mr. Symons procured from one of the locomotive builders three locomotives which had been built for another road, and for some reason were not delivered. They were illustrated in "Modern Locomotives," page 253, specification No. 177, and are the only heavy ten-wheel passenger engines having trailing wheels of which we have record. They were of the two-cylinder compound type and were changed to simple engines before delivery to the Plant System. While the valve motion was known to be unsatisfactory, the state of business compelled their use at the time. Upon placing them in service it was discovered that they were very extravagant in fuel and water, and were "logy," indicating very high back pressure. At the first opportunity indicators were applied and a new valve motion designed in which four eccentric rods weighing 212 lbs. were substituted for the original ones, which weighed 980 lbs. These two forms of valve motion are illustrated in the accompanying engraving, and it is unnecessary to comment upon the comparison. The indicator revealed an astonishing amount of back pressure,

RECORDS OF VALVE GEAR—PLANT SYSTEM.

Card.	Train number.	Mile post.	Weight in tons, working order.	Weight of train in tons.	Total weight engine and train in tons.	Speed per hour, miles.	Revolutions per minute.	Boiler pressure.	M. E. pressure.	Initial pressure.	Back pressure.	I. H. P. of engine.	Scale of spring.	Miles run per ton of coal.	Gallons of water used per mile run.	Ratio in lbs. of coal used to water used.	Pounds of coal used per minute.
1a.	30	116	124	240	364	4	17	180	141.0	157.5	10.25	200.42	80	With modified valve gear. 34 4	With modified valve gear. 51.7	With modified valve gear. 1:7.4	With modified valve gear. 39.2
1.......	53	130	124	212	336	4	17	180	161.5	169.0	2.0	229.56	100				
2a.	30	134	124	240	364	20	86	150	68.6	122.0	43.5	487.56	80				
2.......	53	1	124	212	336	20	86	175	64.7	126.5	3.0	459.76	100				
3a.	30	148	124	240	364	46	198	160	59.5	126.5	19.0	973.01	80				
3.......	53	14	124	212	336	45	194	180	53.5	171.5	5.5	855.91	100	With original valve gear. 20.2	With original valve gear. 67	With original valve gear. 1:5.4	With original valve gear. 67.7
4a.	30	137	124	240	364	60	259	160	45.4	134.5	22.0	968.43	80				
4.......	53	59	124	212	336	60	259	180	50.5	146.5	5.5	1,077.22	100				
5a	30	58	124	240	364	62	267	180	44.0	144.0	18.0	969.81	80				
5.......	53	87	124	212	334	65	280	180	37.0	166.0	7.0	855.00	100				



Indicator Cards with Original Valve Gear.



Indicator Cards with Improved Valve Gear.

the two series of cards taken before and after the change showing the results obtained by the new gear. Other comparisons may be made by aid of the table. The original valve gear was springy, the port openings of the valves were restricted, the nozzle was too small and was opened to the extent of one inch.

Back pressures of 43 lbs., increase of mileage per ton of coal from 20 to 34, and water consumption reduced from 67 to 51.4 gals. per mile run, indicate the situation on these engines. As will be noted by the table, these comparisons, however, are not made at the same speed and not with exactly the same train load, but the difference in speed will not account for all of this loss.

Quoting from Mr. Symons' letter, "There are some forcible and one might say 'knock-down' arguments embodied in these indicator cards which cannot be too strongly commented upon for the benefit of those who are disposed to ignore the use of the indicator on a steam engine, particularly on the locomotive. That there are fortunes annually spent for unnecessary consumption of fuel on locomotives in a condition similar to that shown by cards Nos. 1a to 4a, I feel confident, and unless railroad companies' fuel is looked after and handled a little more in the way in which the treasurer handles his cash, this unnecessary waste will continue."

It is not necessary to add to Mr. Symons' forcible statement.

Cards 1a to 5a were taken with the original valve gear between Jacksonville and Savannah, and cards 1 to 5 with the modified gear, between Savannah and Jacksonville, the grades being about the same in both directions. These engines have 20 by 26-in. cylinders, 78-in. driving wheels, 2,103 sq. ft. of heating surface and 27.8 sq. ft. of grade area.

An important tendency toward increased capacity of British locomotives is indicated by the introduction on the Caledonian Railway of the largest locomotives ever used in that country. These engines have eight 54-in. coupled drivers and no truck wheels. The cylinders are 21 by 26 ins., and the boilers have 2,500 sq. ft. of heating surface. The engine and tender, together, weigh 228,500 lbs.

The advantage given by a technical education seldom stands out as it did in the case of an investigation brought to our attention at one of the locomotive works recently. Having under consideration the subject of tool steel, with a view of improving upon former practice without paying a large royalty for the use of patented processes one of the engineers made a study of the best treatment of steel, and developed a method of hardening a common form so that it would cut a driving axle at 45 ft. per minute with a ¼-in. feed. In spite of all his efforts he could not get the tool steel experts of the shops to follow his directions and produce the results which he had shown them how to produce. At that plant the tool steel has passed out of the hands of the former experts and is now treated by a bright laborer, who was taught to use the process so as to secure the capacity mentioned for the every-day work of the shop.

"Aids to navigation" along the line of the Boston Elevated Road are strikingly plentiful. They take the form of signboards, indicating where the motormen should "coast," "apply air" and "release air," and are repeated all over the road at stations and curves. By following these printed instructions there should be no difficulty in handling trains, especially with automatic block signals and short blocks. This may be a necessary precaution, but it gives an impression of a lack of perfect confidence in the judgment of the men, and this is an important factor in safe operation of railroads.

THE DEMAND FOR RAILROAD MEN.

The apprentice system as applied in the maintenance of way department of the Illinois Central Railroad appears to be very successful. It is fully described in a letter from Mr. John F. Wallace, Assistant General Manager of the road, printed in "Engineering News" (March 8, 1900, page 157). The system was introduced in May, 1897, as a result of the difficulty of securing men with the right kind of qualifications for filling responsible positions in that department. At that time this road had 39 young men on its engineering staff who were taken from the ranks of track apprentices.

Of these, 2 men had reached the rank of assistant engineers at $100 per month, 1 as office engineer at $88.33, 3 as transitmen at $75, 10 as roadmen at $60, 18 as chainmen at $50. The track apprenticeship has been made the doorway to the engineering department, and the lower positions are filled entirely from among the track apprentices, who may or may not be college or technical school graduates. Their subsequent promotions depend entirely upon their relative fitness. Not all continue in this service. Some are attracted away by other opportunities and some move slowly because of lack of fitness. Mr. Wallace said:

"In spite of our effort and desire to fill our road department with educated, capable men, we find it difficult, whenever there is a vacancy in the higher positions, to find a suitable man to fill it. This is mainly because executive ability and the power to control men is a rare faculty. Men are born, not educated, to command, although the efficiency of the born commander is improved by education. I feel that even if we secure only one good man out of ten, the system will have been successful and will recompense us for our work and trouble in connection with it."

Mr. Wallace at our request expressed his opinion of the plan, after further experience, in a letter which has just been received, in which he said:

"The track apprenticeship system has given very satisfactory service, although these results have not been obtained along the exact lines contemplated when the system was originally installed. Our first intention was to give positions as track apprentices to the graduates of technical schools and colleges; assigning these young men to work on the sub-sections of the road, their compensation being $1.25 per day at the beginning and gradually promote them as they prove themselves capable to fill positions as track foremen, track supervisors and road masters. It might be explained in this connection that the position of track supervisor on the Illinois Central compares with that of roadmaster on some systems, and the position of roadmaster to that of engineer of maintenance of way or general roadmaster. Track supervisors have charge of approximately 120 miles of track; roadmasters have charge of track, bridges, buildings and water supply on divisions ranging from 300 to 500 miles in extent.

"Owing to the large number of men who applied for the positions as track apprentices, and their quality, it was not considered fair to the young men to confine their promotion entirely to the position of track foremen; it was therefore made a rule of the engineering department that all vacancies in the lower ranks of that department, viz., axmen, chainmen, rodmen, etc., should be filled from among these track apprentices; the result is that the track apprenticeship has been made the door to the engineering department on the Illinois Central Railroad, and rarely has any position been filled in this department except from among these track apprentices, they being first appointed axmen or chainmen, then promoted to rodmen, instrument men and assistant engineers, as the vacancies occurred above them.

"The large amount of construction work on the system has made such drafts upon the apprentice class that these young men have rarely been kept as track apprentices more than one year, and the majority have been promoted to the engineering department; several, however, after employment as chainmen, rodmen, instrument men and assistant engineers, have returned to the road department as track supervisors and roadmasters; the knowledge which they have received in the practical track work being one of the principal factors in securing these positions for them. The knowledge obtained of track work has been of material advantage to those who have continued in the engineering department, particularly those who have been engaged in the construction of yards and track facilities; it has, also, had the effect of primarily weeding out incompetent and undesirable young men and retaining only those whose enthusiasm has enabled them to go through approximately a year of hard and laborious work. Greatly to my surprise a much smaller portion of these young men have 'flunked' than was originally expected, the greater number remaining and attaining positions of responsibility."

This testimony is valuable, chiefly because it points conclusively to two facts. First, that it is exceedingly difficult to find the right men for leading positions. Second, that of all kinds of abilities, that of the executive or commander is the rarest.

During the past two years it has become apparent through the number of applications received at this office from Superintendents of Motive Power that the same thing is true of the mechanical department and that there is a demand for men with executive ability, who are able to organize forces and manage affairs of various kinds. In fact, good, experienced young men with technical training supplemented by sufficient shop and executive experience, who are ready for any position from gang or floor foremen to Superintendent of Motive Power have been sought for as they never have been before.

It may be easy to get an unlimited supply of track engineers after the method of the Illinois Central with the very low salaries already mentioned, but there can be no doubt that in the compensation question lies much of the trouble in which the mechanical department finds itself. Railroads do not pay their mechanical officers enough. It is pure absurdity to pay a locomotive runner more than a Master Mechanic, who has the charge of many runners, besides the engines and shops, and yet this is done on every side. Only a short time ago one of the best young motive power officers in the United States was lost to the railroads because he could make a great deal more money in a manufacturing concern.

The motive power department of one of our great railroads to-day demands more of its chief than is asked of managers of even the largest manufacturing establishments, and yet they leave the railroads to double their salaries in an industrial concern, and they are not to be blamed. We hope that time will correct this, but the railroads will pay a heavy price for every moment of delay. The trouble extends all along down the line, and in the large number of applications received by us from Superintendents of Motive Power, the best of men are asked for and salaries are mentioned which are ridiculously out of proportion to the requirements and responsibilities.

Railroads need to do two things for their mechanical men: Pay them better and institute such organizations as will make promotion more certain to follow ability and faithfulness.

In the demand for men with executive experience we see a suggestion for the technical school graduate.

The greatest work ever undertaken in Egypt in regard to discharging coal from steamers has just been completed in Alexandria. The machinery that towers above the surrounding ships owes its origin to Mr. Alexander E. Brown, an American engineer, who has invented a system of suspended bridge tramways, whereby colliers could be unloaded automatically in about one-quarter of the time taken by manual labor and the use of steam winches. The Egyptian Railway Administration decided to adopt this system; the present apparatus is the first that has been installed in Egypt.—Consul Long, in a letter from Cairo.

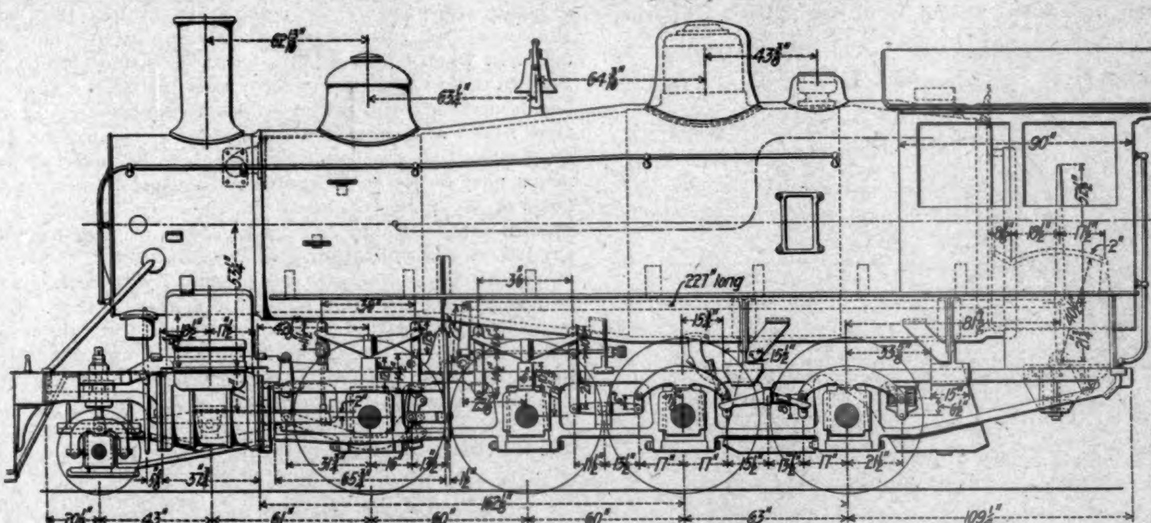
CONSOLIDATION FREIGHT LOCOMOTIVE.

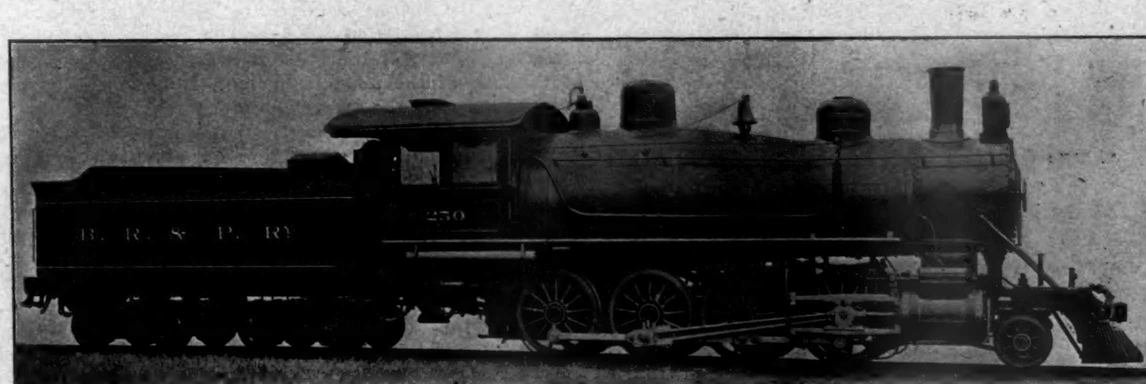
With Vanderbilt Boiler.

Buffalo, Rochester & Pittsburgh Railway.

Baldwin Locomotive Works.

Since the first Vanderbilt boiler was applied to a 10-wheel locomotive on the New York Central (American Engineer, September, 1899, page 279) the arrangement has not been changed materially except to make the taper sheet a true cone and locate the corrugated flue in such a way with reference to the tubes and the outer shell as to equalize the diagonal stresses. This is clearly indicated by a comparison of the earlier drawings with those of a new engine which has just been placed in service on the Buffalo, Rochester & Pittsburgh Railway, shown in connection with this article. This is a simple engine with 2,585 sq. ft. of heating surface and 33 sq. ft. of grate area. It is a heavy engine, with 151,900 lbs. on the driving wheels, and has balanced slide valves. The rockers are placed immediately back of the cylinders and have cross-head connections to the valve stems. To pass the leading driving axle with the valve gear a suspended motion rod is used. The following list of dimensions presents the chief characteristics of the engine:





Consolidation Freight Locomotive With Vanderbilt Boiler—Buffalo, Rochester & Pittsburgh Railway.

C. E. TURNER, *Superintendent of Motive Power*. BALDWIN LOCOMOTIVE WORKS, *Builders*.

General Dimensions.

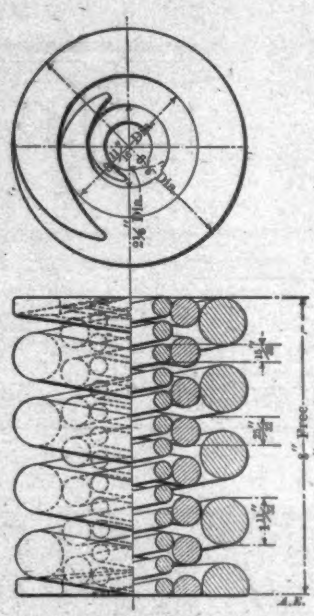
Gauge	4 ft. 8½ ins.
Kind of fuel to be used	Bituminous coal
Weight on drivers	151,900 lbs.
Weight on truck wheels	17,700 lbs.
Weight, total	169,600 lbs.
Weight, tender, loaded	120,000 lbs.
Wheel base, total, of engine	23 ft. 11 ins.
Wheel base, driving	15 ft. 3 ins.
Wheel base, total, engine and tender	53 ft. 7¾ ins.
Length over all, engine	42 ft. 6 ins.
Length over all, total, engine and tender	63 ft. 5 ins.
Height, center of boiler above rails	8 ft. 4¼ ins.
Height of stack above rails	14 ft. 8¾ ins.
Heating surface, firebox	135 sq. ft.
Heating surface, tubes	2,450 sq. ft.
Heating surface, total	2,585 sq. ft.
Grate area	33 sq. ft.
Drivers, number	8
Drivers, diameter	56 ins.
Drivers, material of centers	Cast steel
Truck wheels, diameter	30 ins.
Journals, driving axle, size	9 by 10 ins.
Journals, truck axle, size	6 by 10 ins.
Main crank pin, size	6½ by 6½ ins
Cylinders, diameter	22 ins.
Piston, stroke	28 ins.
Piston rod, diameter	3¾ ins.
Kind of piston rod packing	United States Multi-Angular
Main rod, length center to center	10 ft. 4¾ ins.
Steam ports, length	19 ins.
Steam ports, width	1⅜ ins.
Exhaust ports, length	19 ins.
Exhaust ports, width	2¾ ins.
Bridge, width	1⅛ ins.
Valves, greatest travel	5¾ ins.
Valves, outside lap	⅞ in.
Valves, inside lap or clearance	0 in.
Valves, lead in full gear	1/16 in.
Boiler, type of	Vanderbilt
Boiler, working steam pressure	200 lbs.
Boiler, material in barrel	Steel
Boiler, thickness of material in barrel	11/16 in. and ¾ in.
Boiler, diameter of barrel	66 ins.
Seams, kind of horizontal	Sextuple riveted butt joint
Seams, kind of circumferential	Double riveted lap
Thickness of tube sheets	½ in.
Dome, diameter	30 ins.
Firebox, length	94 ins.
Firebox, width at grate	57 ins.
Firebox, material	Steel
Firebox, thickness of sheets	⅜ in.
Tubes, number	377
Tubes, material	Iron
Tubes, outside diameter, No. 12 W. G.	2 ins.
Tubes, length over sheets	12 ft. 6 ins.
Smoke box, diameter	66 ins.
Smoke box, length	59¼ ins.
Exhaust nozzle, double	High
Exhaust nozzle	Permanent
Exhaust nozzle, diameter	3¾ ins., 4 ins. and 4¼ ins.
Exhaust nozzle, distance of tip below center of boiler	4⅝ ins.
Netting	Wire
Stack	Straight
Stack, least diameter	18 ins.
Stack, greatest diameter	19¾ ins.
Stack, height above smoke box	3 ft. 7 ins.
Type of tender	4-wheel swivel truck
Tank capacity for water	6,000 gals.
Coal capacity	10 tons

LARGE CAPACITY DRAFT SPRING

For Freight Cars.

C., C., C. & St. L. Ry.

In the recent report to the M. C. B. Association on draft gear it was stated that Mr. William Garstang, of the C., C., C. & St. L. Ry., is using draft springs of larger capacity than those of the recommended practice of the association, but without exceeding the dimensions of that practice. By courtesy of Mr. Garstang we illustrate his new spring, which has three coils instead of two, and has a capacity of 28,000 lbs., an increase of 9,000 lbs. over the usual practice. The free height of 8 ins. is retained and the outside diameter of the large coil is 6⅝ ins., ⅛ in. larger than before. This new spring employs coils having bars 1 11/32, 25/32 and 15/32 in. in diameter respectively and its normal weight is 40 lbs. The height when



Large Capacity Draft Spring.

solid is 6 ins., and the height under a load of 28,000 lbs. is required to be 6 1/16 ins. It is obvious that this spring may be used in the ordinary draft gear having a yoke attachment, and that 50 per cent. increase in capacity over the usual practice is obtained very easily and cheaply. If used in a twin or tandem gear these springs would give a capacity of 60,000 lbs., a very respectable increase over the usual construction; but Mr. Garstang uses them singly on all new cars and in replacements. The outer coil tested alone to 6 ins., requires a pressure of 16,700 lbs.; the second coil alone, 5,400 lbs., and the inner coil alone, 1,400 lbs. Compressed separately to 6 ins., the coils thus have in all 23,500 lbs. capacity, but when assembled, a little over 28,000 lbs. is required to compress the group to 6 ins. The difference is accounted for by the friction of one coil on another.

A ventilating fan running backward was found by Prof. R. C. Carpenter in one of the Cornell University buildings some time ago. The fan had been operated for about three months when a cold snap came along and it proved impossible to warm the place. The fan was found in the condition stated, and the motor was reversed and not only was there an increase in the air delivery, but the amount of electric current fell off. Where it took 22 amperes to drive the fan backward, delivering very little air, it required but 12 amperes with the fan running in the right direction and delivering six or eight times as much air.—"Engineering Record."

CORRESPONDENC.

THE SLIDE RULE.

Most Valuable Draftsman's Assistant.

To the Editor:

"Why Don't Draftsmen Use the Slide Rule?" Speaking as one who is well acquainted with the uses of the slide rule, it is quite surprising that there is such a noticeable lack of use of this extremely handy and fairly efficient instrument among draftsmen.

I have seen draftsmen who had at times a number of calculations to make on work in connection with a locomotive elevation, that after a few hours of worry over a mass of figures, were about worn out for the remainder of the day, solely because of the mental drudgery due to following every simple but necessary step in nothing more than an ordinary calculation. On the other hand, I have seen the draftsman who used the slide rule, engaged on the same class of work, who easily did the same amount of calculating in less than one-fourth the time and with no more mental fatigue than ordinarily acquired when trying a point on an elevation. And the chances for errors are greatly reduced when using the rule. Nothing has impressed upon me more deeply the amount of labor and time saved and mental drudgery overcome by the aid of the slide rule than the conditions seen in the majority of draftsmen's note-books as compared with what is seen in the notebook of the man who uses the rule. In the notebook of the former can be found page after page of long-drawn-out examples of multiplication and division—usually three-fourths of the book's contents is composed of just such stuff as can be taken from the slide rule in a moment's time. One would imagine that draftsmen who do not use the rule would make use of the logarithm tables instead of working out long multiplication and division. I have yet to meet the draftsman who makes regular use of these tables in his work. When a calculation is noted by the draftsman who uses the slide rule all that will be found in his notebook is the formula, this followed by substituting for the letters their values in figures, then the answer, of course, all arranged algebraically. This not only saves time and labor, but simplifies matters so that they may be readily referred to without going over a whole mass of figures before getting the results desired.

Here are some of the reasons that may account for the lack of the use of the slide rule among draftsmen. Many are of the opinion that the results obtained from the rule are at best poor approximations, that the rule was devised for work that is a little better than guessing, such as rough estimating, and also useful in checking. The rule will do all this and more. As a draftsman, I have found the rule sufficiently accurate for all practical purposes, except in a very few instances. In other words, I mean that if you were to figure for stresses with the rule, say, in crank pins or a guide yoke or for the capacity of a tender tank, the results obtained would be near enough to the actual stresses in the parts named and to the actual capacity of the tank to be accepted as correct, as I have found. Of course, this is supposing you know how to use the rule well enough to read your results within the usual allowed limit for error, which is less than one-half of one per cent., or an error of 1 in every 200.

Some beginners in the use of the rule have trouble in bringing themselves to the point of accepting results from it because they are so accustomed to seeing every step in working out an example put down on paper. When they are in error they are too ready to blame the rule, whereas, the rule never makes a mistake. The varying subdivisions of the various scales are puzzling to the eye of the beginner, and there is some difficulty in becoming familiar with the arrangement. This, I believe, is the only real difficulty in learning to use the rule, but with some practice and a little patience this can be overcome. Some complain of trouble in finding the decimal point on the rule. With the few users I know and in my own case there was no trouble about this after once becoming thoroughly familiar with the subdivisions. The principal fault with beginners, I find, is that they try to learn too much on the start. Before they are able to readily read from the scales they are branching off into square and cube roots, logarithms, etc., which is entirely wrong. Beginners should confine themselves to multiplication and division until they can read the subdivisions accurately and without much hesitation, then

take to checking up results given in the many mathematical tables in reference books. These tables cannot be used too much for this work, because it is the best kind of slide rule practice.

There are also many draftsmen who hesitate about taking up the slide rule because they believe it requires an extensive knowledge of mathematics, especially a knowledge of logarithms. The scales of the slide rule are divided into a logarithmic series, arranged so they may be placed side by side and one moved over or by the other. It is in this way that the divisions or logarithms are added, thus multiplying the numbers, or subtracted and dividing the numbers. These and all the many operations on the rule are done mechanically. Anyone with a knowledge of multiplication and division can learn to perform these on the rule. Of course, the more extensive one's knowledge of mathematics the more extensive will be his application of the rule.

I prefer to use the straight slide rule, ten inches long, the sliding index of glass with a hair-line across its face; the glass is enclosed by a small aluminum frame. The improved rule with the slits through the back of the stock, which is to prevent the sliding scale from binding in the stock, should be used. With any other rule this binding will be found quite annoying, especially during damp weather. I find the straight rule more convenient to handle and its celluloid face, I believe, will stand fingering better than the cardboard of the so-called circular slide rule. The circular rule has the advantage of giving one more figure, which is desirable, and it also gives the fifth root direct without the use of logarithms, as with the straight rule.

The little pamphlet that is given with the slide rule when purchased contains all the instructions required in learning to use the rule. This may be supplemented by what has been written on the subject, and may appear from time to time in the various technical journals. That the draftsman and the up-to-date mechanic, or, in fact, anyone who has calculating to do, would be more than repaid for the time and patience spent in learning to use the rule is the least that can be said on this point. And that the draftsman who uses the rule will have a distinct advantage over his fellow draftsmen, engaged on the same class of work, but who do not make use of it, there is no doubt. It is also most likely he will agree with me in saying that the slide rule is the most valuable instrument to a draftsman that was ever laid down on the drawing board.

LAWRENCE B. MELVILLE,
Richmond Locomotive Works.

MASTER MECHANICS' ASSOCIATION COMMITTEES FOR 1901.

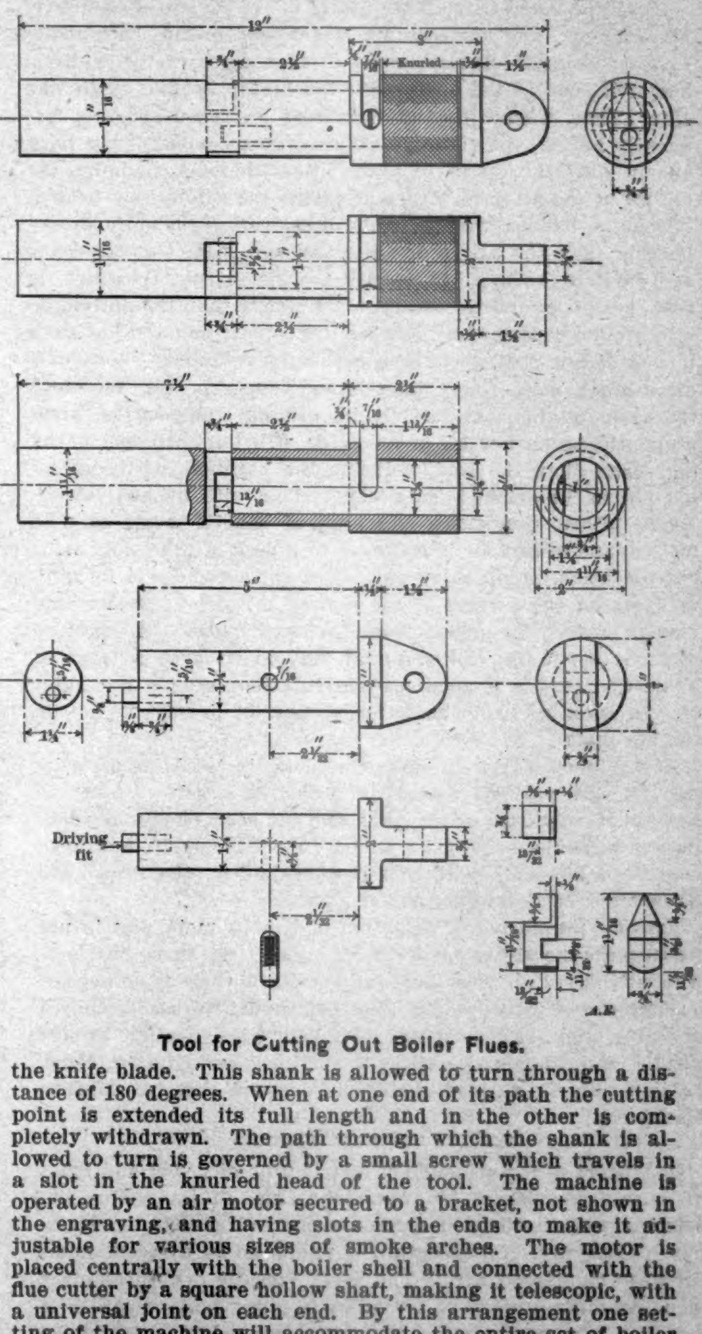
At a meeting of the Executive Committee of the American Railway Master Mechanics' Association held on August 15, 1901, the following committees for conducting the work of the association for the year 1901-1902 were selected:

1. Ton-Mile Statistics: H. J. Small, chairman; C. H. Quereau, W. H. Marshall, Geo. L. Fowler.
2. What Is the Cost of Running High-Speed Passenger Trains? Wm. McIntosh, chairman; J. F. Deems, G. F. Wilson, Prof. W. F. M. Goss.
3. What Should Be the Arrangement and Accessories of an Up-to-Date Roundhouse? Robert Quayle, chairman; V. B. Lang, D. Van Alstine, G. M. Basford.
4. Present Improvements in Boiler Design and Best Proportions of Heating and Grate Surface for Different Kinds of Coal: Geo. W. West, chairman; T. W. Demarest, H. D. Taylor, M. N. Forney.
5. Standard Specifications for Locomotive Driving and Truck Axles: A. E. Mitchell, chairman; S. Higgins, W. S. Morris, L. R. Pomeroy.
6. Internal Combustion Engines in Railroad Work: R. P. C. Sanderson, chairman; M. K. Barnum, C. M. Mendenhall, John A. Hill.
7. Subjects: A. E. Manchester, chairman; Howard Stillman, Alfred Lovell.

In addition to the above it is expected there will be three or four papers by individual members of the association; and these, together with the topical discussions, will complete the program for the work of the next convention.

NEW FLUE CUTTING MACHINE.

A very efficient machine for cutting out flues in locomotive boilers has recently been developed at the Burnside shops of the Illinois Central Railroad. The accompanying engraving shows one of these tools for cutting 2-in. flues from the front end of a boiler. To remove a set of flues requires two of these cutters, one for the front and another for the back end of the boiler. The only differences in the two tools are the diameter of the shank which fits into the end of the tubes and the location of the knife in the shank. The cutting action is accomplished by means of a small knife, shown in the lower part of the engraving, the point of which is brought into action and withdrawn by means of a ⅜-in. pin, one end of which is off-centered in the end of a smaller shank that turns in the body of the tool, and the other end of the pin works in a groove in



Tool for Cutting Out Boiler Flues.

the knife blade. This shank is allowed to turn through a distance of 180 degrees. When at one end of its path the cutting point is extended its full length and in the other is completely withdrawn. The path through which the shank is allowed to turn is governed by a small screw which travels in a slot in the knurled head of the tool. The machine is operated by an air motor secured to a bracket, not shown in the engraving, and having slots in the ends to make it adjustable for various sizes of smoke arches. The motor is placed centrally with the boiler shell and connected with the flue cutter by a square hollow shaft, making it telescopic, with a universal joint on each end. By this arrangement one setting of the machine will accommodate the entire set of boiler tubes. The time required in cutting out a set of 232 flues from the front end of a boiler, including the time for applying and removing the apparatus, is 1 hour and 25 minutes. We are indebted to Mr. W. H. V. Rosing, Assistant Superintendent of Machinery of the Illinois Central Railroad, for information and drawings from which this engraving was prepared. The machine is now being manufactured by F. B. Redington & Co., 340 West Monroe street, Chicago.

EFFECT OF HEAT ON BABBITT METAL

Almost any solid metal for lining bearings is called by the name "babbitt metal," while in fact few of the soft linings used have any claim whatever to that title. The genuine alloy which was compounded by John Babbitt, and which bears his name, is composed of eight parts of regulus of antimony (regulus means the pure, refined metal), four parts copper and ninety-six parts of tin.

Ordinary soft lining, so-called babbitt metal, frequently is made up of four parts lead and one part antimony. Old type metal is also used for lining, and consists of two parts lead, one part tin, and one part antimony. Britannia metal (pewter) is much used for lining, and this consists of nine parts tin and one part antimony.

It will be noted that all the alloys above described are partly of antimony, and also contain either lead or tin, both easily oxidized metals. But antimony is even more easily oxidized, and will burn in the open air if too highly heated, much like zinc. Thus, when either of the alloys described above is frequently heated, the different metals become oxidized, but burn out in different ratios to each other, thereby changing the nature of the alloy to a certain extent each time it is heated.

Genuine babbitt will probably change its form more by reheating than the alloys of antimony and lead, but the latter are reduced the most in quantity. The reason, therefore, is that the copper and tin oxidize more slowly than the antimony, which quickly burns out, leaving the babbitt much softer than it was before getting rid of some of its antimony. Lead oxidizes much more freely than either copper or tin, therefore the alloy retains more nearly its original composition when a quantity is burned off or oxidized; still the antimony burns out faster than the lead, reducing the hardness of the alloy, but not to the extent it does when mixed with tin and copper. Under proper conditions, any kind of babbitt metal may be melted, and even kept indefinitely in a molten condition without oxidation, or, in every-day language, without the forming of dross on the surface of the molten metal. To secure this result, protect the metal from the atmosphere. A layer of dirt on top of the molten metal will do it; even a layer of oxide or dross is a good preventive; therefore do not skim off the layer of oxide as it forms, but let it stay on top of the hot metal.

A very good way is to cover the metal in the ladle or melting pot with pulverized charcoal. Carbon largely retards the process of oxidation, and if some salt and soda (common washing and cooking soda) be added to the coarsely powdered charcoal, the oxide will be reduced—that is, the dross will be smelted back into the metal again.

Another preventive of oxidation of babbitt metal lies in not heating the metal too hot. For all except very small bearings, where the layer of metal must run very thin, there is no need of heating the metal very hot. Just hot enough to barely char a dry pine stick, is a good rule to follow when heating babbitt metal. But whittle the stick every time the metal is tested, so that a fresh wooden surface is exposed thereto.—Modern Machinery.

In support of the principle of distribution of power and long-distance transmission by compressed air, an interesting account of the distribution system of natural gas by the Pittsburgh Company, of Pittsburgh, is published in a recent number of "Compressed Air." The West Virginia system of pipes alone contains upward of 200 miles of pipes, none of which is less than 8 in. in diameter. The entire product is forced to the city by its own well pressure, which is so regulated as to produce about 265 lbs. at the West Virginia end. There are other plants of this description in the gas regions of the United States, the lines in some cases being 70 miles long. This company has a total of about 1,300 miles of pipe, most of which is worked at a fairly high pressure. This is good evidence that air can be transmitted successfully and economically.

A WASTE-HEAT ENGINE.

The fundamental principle of this waste-heat engine is to increase the total usefulness of the ordinary condensing engine by using a part of the heat that is given off as a waste, to do useful work. This is accomplished by Professor E. Josse, of the Royal Technical High School of Berlin-Charlottenberg, by using the ordinary surface condenser, into which the steam of the engine exhausts, as a boiler for evaporating sulphur dioxide (SO_2). Part of the heat in the condensing water is thus used to evaporate the sulphur dioxide, which is in turn used to drive a vapor engine. This second engine is connected with a condenser, from which the sulphurous acid is drawn off by a little vapor pump and returned to the original condenser of the steam engine.

Sulphur dioxide vapor, at a temperature of 140 degs., which corresponds to a vacuum of 24 ins. in the cylinder of an engine, is known to have a pressure of 156.6 lbs. per square inch absolute; and at 60 degs., the temperature of the condenser cooling water, it has a pressure of 40.8 lbs. per square inch absolute. It will readily be seen that under these conditions the sulphur dioxide may be used for developing power in the cylinder in expanding from 156.5 lbs. to 40.8 lbs. per square inch.

The engine used for experimental work in this connection is a 150-horse-power triple-expansion engine, installed at the Technical High School of Berlin-Charlottenberg. It has cylinders 10⅝ and 16 15/16 and 26 9/16 by 19 11/16 ins., the vapor cylinder having a diameter of 16 15/16 ins., and the same stroke as the steam piston. The steam condenser or vaporizer has 753 ft. of cooling surface, and the sulphur dioxide condenser 1,720 sq. ft.

Tests of the steam engine alone and of the combined engines show that the steam consumption per i. h. p.-hour was reduced to 8.34 lbs. The total output was 170 i. h. p.-hours. Of the total power of the engine about three-quarters of one per cent. is required to run the sulphur dioxide feed pump.

From the data now available, Prof. Josse believes that in large combined engines of a capacity from 1,200 to 2,000 horse-power, the steam consumption would be reduced to 7 lbs. per i. h. p.-hours, but in small steam plants, or where operation is only for a few hours each day, he does not consider this engine suitable. With the use of the waste-heat engine every precaution must be taken to have all joints and packings perfectly tight, as sulphur dioxide is readily oxidized when in the presence of atmospheric air or water, and forms sulphuric acid, which has a destructive effect on the metal. It is stated that no trouble has been experienced from this source, and examinations of both the vapor engine and condenser, after more than a year's operation, show them to be in perfect condition. One of these engines is now in operation in one of the stations of the Berlin Electric Lighting Company. The steam engines are 360 horse-power, and consume about 40 lbs. of steam per i. h. p.-hour. The vapor engine installed utilizes 175 horse-power from the waste heat of the steam engine.

Returns from the letter ballot of the M. C. B. Association on questions submitted after the recent convention, show that all of them are decided in the affirmative, that is, they are all adopted.

Mr. J. N. Barr, Mechanical Superintendent of the Baltimore & Ohio, has accepted the position of Mechanical Superintendent of the Erie. Mr. Barr has had a very successful experience, both as a mechanical officer and as an administrator. He began his railroad career in the Pennsylvania shops at Altoona. From 1885 to 1899 he held consecutively the positions of Mechanical Engineer, Superintendent of the Car Department and Superintendent of Motive Power of the Chicago, Milwaukee & St. Paul. On November 1, 1899, he became Mechanical Superintendent of the Baltimore & Ohio, which position he now leaves for his new appointment.

A WELL-ARRANGED BRASS FOUNDRY.

Special attention is being given at this time to the better equipping of brass foundries in railroad shops, and to those having the subject under consideration, the accompanying engravings, showing the general lay-out of a brass foundry that has given excellent service in a plant for making brass fittings for steam and gas, may be suggestive. This foundry, described in a recent issue of the "American Machinist," is about 45 ft. wide and 60 ft. long, and, as will be seen from Fig. 1, provision is made for six molders. Instead of the usual arrangement of troughs for holding the sand and flasks while the molds are being made, the stall system is used. These molding troughs, which are common in most foundries, have the objection of not holding sand enough for more than one heat, and as a molder usually puts up three heats in a day, he is obliged to use the hot sand over again, which is not conducive to the best castings and in warm weather is very trying on the men. Fig. 2 shows the arrangement of one of the molding stalls as they are used in this foundry. Each stall is 4 ft. long, 4 ft. wide and 3 ft. high, made of 1-in. hemlock plank. A bracket of 2 by 4-in. hemlock is fastened to the wall of the stall at a convenient height for the molder and the ledge on the left partition of each stall provides a place for the patterns, matches, etc., as they are taken from the mold. By this stall arrangement each molder has the advantage of a large window which furnishes plenty of light and air and also has the advantage of plenty of sand always ready in two piles, one at the upper end and a second pile to the right of the entrance to the stall. While one heat is being poured the second pile of sand is shoveled to the back end ready for use. Such tools as are used by the molder are hung on pegs, or placed within easy reach of the operator.

In the construction of the furnaces two pulley rims marked a in Fig. 3 have been used. These rims are about 34 ins. in diameter, with a 13-in. face 1 in. thick. The top and bottom plates, b, are made of cast iron, with two bars, c, 1½ ins. thick, placed one on each side of the two bottom plates to allow space for the cast iron grate bars marked d. These grate bars are 1 in. square and 40 ins. long; the ends, d, projecting beyond the furnace for the purpose of shaking or dumping the fire. The lining of the furnace is of rectangular fire-brick, which is cheaper and easier to obtain than the segmental shapes. In using the rectangular brick care should be taken to fill all the crevices with fire clay and the space between the brick and casing with pieces of old fire-brick and clay. Each of the six furnaces is connected to a large brick flue, f, by small flues, e, made of 6-in. wrought iron pipe. The main flue is built of common brick, and so constructed that six more furnaces can be built on the opposite side when necessary. To support the brick top of this flue, cast iron T-rails are used. The flue leads to a stack 20 ins. in diameter by 40 ft. high and furnishes excellent draft. In front of the furnaces, which are set upon brick piers, is a pit deep enough for a man to walk in, while

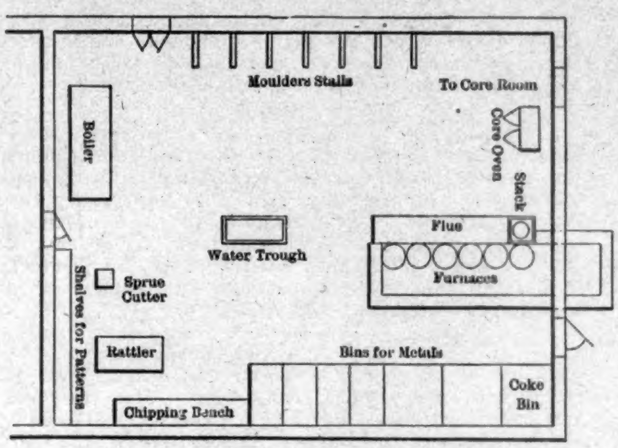


Fig. 1.—Plan View of Foundry.

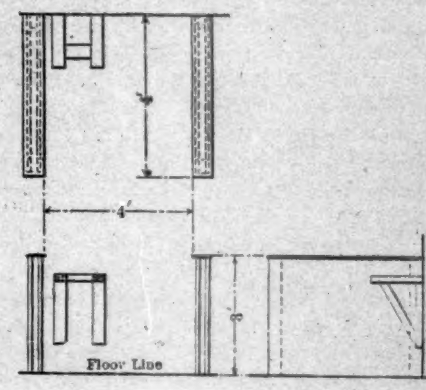


Fig. 2.—Molding Stall.

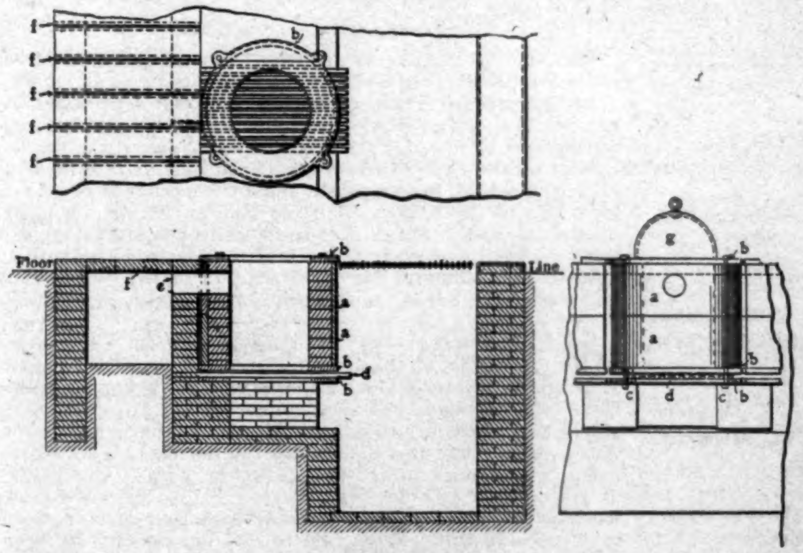


Fig. 3.—Brass Furnace.

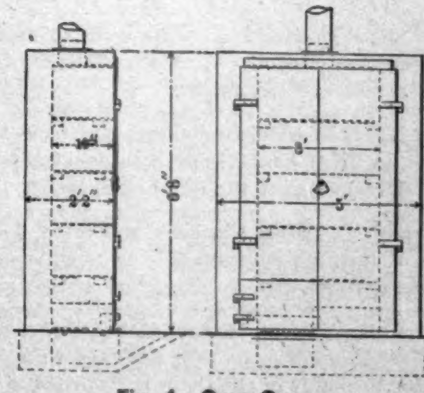


Fig. 4.—Core Oven.

removing the ashes. The pit as shown in Fig. 1 extends outside of the building so that the handling of ashes does not come into the foundry. To keep the pit clean and free from water there should be a sewer connection, with the bottom of the pit sloping to the opening.

A very effective furnace for baking cores is shown in Fig. 4. It is very simple and can be built cheaply. The walls and top of the oven are common brick with cast-iron tee-bars used only to hold the top bricks in position. Two doors made of sheet iron are placed on the fire side so as to get at the fire without exposing the entire oven. The same pattern of cast iron grate bars is used as in the brass furnace. The shelves for holding cores may be made of 3-16 or ¼-in. boiler plate, punched full of ¾-in. holes or made of cast iron. In the case of the latter they do not warp, but the expense of the pattern hardly justifies their use. The fuel used for both the furnace and oven is gas-house coke and is stored away in the yard outside of the foundry; only enough for a single day's run is brought to the coke bin shown in Fig. 1, in connection with the bins for metals. The core room is attached to the main building, not shown in the engraving.

In the center of the floor of the foundry will be noticed a trough for running water used in dipping castings. To obtain a rich color such as seen on valves and cocks, it is necessary to set the color by dipping at a certain temperature, although the same color is procured in a cheaper metal by dipping in acid. The use of water has the advantage that it causes the cores to be blown out, leaving the inside of the castings clear and thus saving considerable expense. For convenience in lifting and carrying the crucibles to a clear space on the floor for skimming and making ready to carry to the molds, a trolley and chain hoist is placed over the furnace. The floor of the foundry is paved so that by sweeping each day, the brass that is spilled in pouring is saved. In this floor a hard brick is used, but for hard service the vitrified brick would doubtless be the cheaper in the end.

PERSONALS.

Mr. L. R. Johnson has been appointed Assistant Superintendent of Rolling Stock of the Canadian Pacific.

Mr. M. J. Collins has been appointed Assistant General Purchasing Agent of the Atchison, Topeka & Santa Fe system, with offices at Chicago, Ill.

Mr. D. J. Durrell, Mechanical Engineer of the Pennsylvania Lines, at Columbus, O., has been appointed Assistant Engineer of Motive Power of the Southwest system.

Mr. W. C. Dallas has been appointed Assistant Superintendent of the Locomotive and Car Department of the Missouri Pacific system, with headquarters at St. Louis, Mo.

Mr. J. H. Watters, Master Mechanic of the Louisville & Nashville at Anniston, Ala., has resigned to accept the position of Master Mechanic of the Georgia Railroad at Augusta, Ga.

Mr. Thomas Tipton, formerly Purchasing Agent of the Rio Grande Western, has been appointed Assistant Purchasing Agent of the Denver & Rio Grande, with headquarters at Denver, Colo.

Mr. G. R. Joughins, Mechanical Superintendent of the Intercolonial, at Moncton, N. B., has resigned. Mr. Joughins was formerly Superintendent of Motive Power of the Norfolk & Southern, and has had a successful railroad experience.

Mr. Lester S. Carroll, Assistant Purchasing Agent of the Chicago & Northwestern and the Fremont, Elkhorn & Missouri Valley, has been appointed Purchasing Agent, with headquarters in Chicago, in place of Mr. Charles Hayward, resigned.

Mr. A. A. Maver has been appointed Master Mechanic, in charge of the Montreal shops of the Grand Trunk, to succeed Mr. J. E. Muhlfeld, resigned. Mr. T. A. Summerskill has been appointed Master Mechanic of the Northern Division, with headquarters at Allendale, Ont., in place of Mr. W. Ball, resigned.

Mr. A. McCormick, Master Mechanic of the Rock Island & Peoria, has been appointed Master Mechanic of the southwestern division east of the Missouri River of the Chicago, Rock Island & Pacific, to succeed Mr. John Gill, resigned. Mr. McCormick will have charge of the locomotive and car departments, with headquarters at Trenton, Mo.

Mr. C. H. Wiggin has been promoted to succeed Mr. P. M. Hammett as Assistant Superintendent of Motive Power of the Boston & Maine, with headquarters in Boston. Mr. Wiggin has been connected with this road for a number of years and in 1891 was appointed Master Mechanic at Concord, N. H., of the Concord and White Mountains divisions. He is succeeded in that position by Mr. D. E. Davis and Mr. Davis is succeeded as Master Mechanic at Boston by Mr. C. B. Smith.

Mr. Charles T. Bayless has been appointed Mechanical Engineer of the Mexican Central Railway, with headquarters in the City of Mexico, Mex. He has acted in the capacity of Mechanical Engineer for about five years under the title of Chief Draftsman. The present appointment is the first time this position has been established officially on this road. Mr. Bayless was formerly associated with the late David L. Barnes in Chicago, and had to do with a large number of designs of well-known equipment specialties.

Mr. A. E. Mitchell, Mechanical Superintendent of the Erie Railroad, and one of the best-known Motive Power officials in the railroad field to-day, has resigned after 15 years of service with that road. Prior to his service on the Erie he was an apprentice in the Baldwin Locomotive Works and Altoona shops, was afterward with the Yale & Towne Manufacturing Company, and for several years in a variety of railroad and manufacturing service. Since 1886 he has held the positions of engineer of signals, engineer of tests, mechanical engineer and superintendent of motive power of the Erie Railroad, the last title having been recently changed to mechanical superintendent.

Mr. Amos Pillsbury has retired from the position of Superintendent of Motive Power of the Maine Central at his own request after many years of faithful railroad service which began in 1852 as machinist on the New York, Hartford and Springfield Railroad. From 1853 to 1855 he worked as a machinist on the Baltimore & Ohio; from 1855 to 1880 he was machinist, general foreman and master merchanic of the Hartford, Providence & Fishkill; from 1880 to 1881 Master Mechanic of the Cleveland, Akron & Canton Railroad; from 1881 to 1885, Superintendent of Rolling Stock of the Eastern Railroad; from 1885 to 1894, General Master Mechanic of the Maine Central, and since 1894, Superintendent of Motive Power of that road.

Mr. F. D. Casanave has resigned as General Superintendent of Motive Power of the Pennsylvania Railroad to succeed Mr. J. N. Barr as Mechanical Superintendent of the Baltimore & Ohio. Mr. Casanave has been connected with the Pennsylvania since 1862, when he entered the Altoona shops as an apprentice. After completing the apprenticeship he entered the drafting room, where he remained until 1875. He served about one year as inspector of locomotives and after being detailed for special work in the department was made Assistant Master Mechanic at Altoona in 1876. From 1881 to 1887 he was Master Mechanic at Fort Wayne and from 1887 to 1893 Superintendent of Motive Power of the northwest system of the Pennsylvania Lines. In March, 1893, he was appointed General Superintendent of Motive Power of the Pennsylvania Railroad lines east of Pittsburg and Erie.

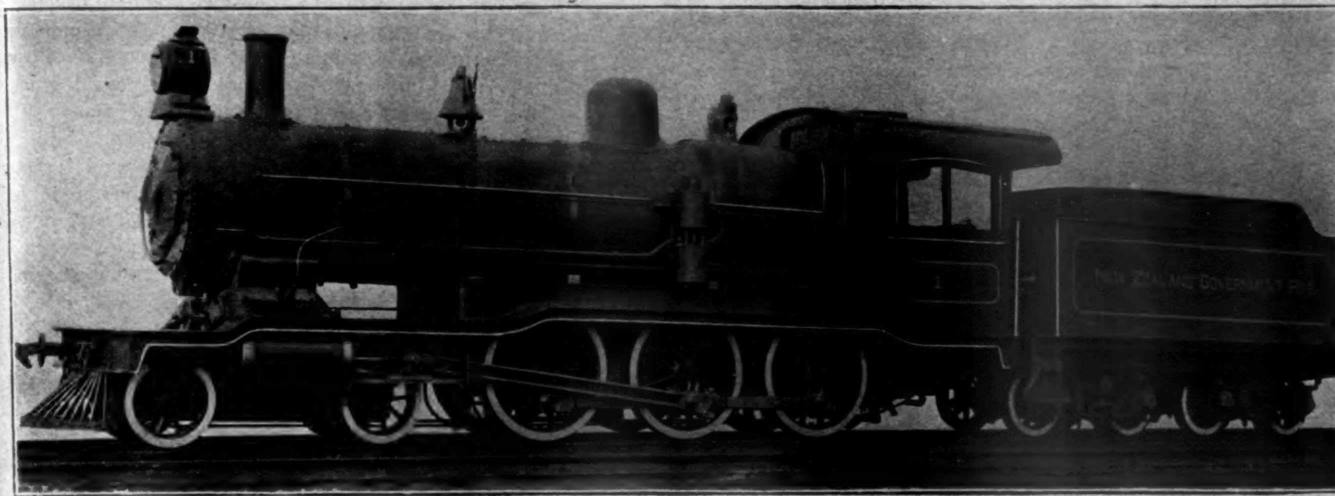
Mr. Philip M. Hammett has been appointed Superintendent of Motive Power of the Maine Central to succeed Mr. Amos Pillsbury, who retires from that office at his own request after a long term of faithful service. Mr. Hammett is 34 years of age and has a remarkable record in motive power service. After graduating from Harvard University in 1888 he completed his engineering education at the Massachusetts Institute of Technology in 1890, and entered the mechanical department of the Pennsylvania Roalroad as a special apprentice. From this time his advancement has been rapid. In 1893 he was made general foreman of the Wilmington shop of the P. W. & B. Railway and in 1896 Master Mechanic of the Boston & Maine. The latter position he held for four years, until his appointment as Assistant Superintendent of Motive Power of that road in September of last year. He goes to the Maine Central with an excellent experience and preparation, both technical and practical.

TEN-WHEEL NARROW-GAUGE PASSENGER LOCOMOTIVE.

New Zealand Government Railways.

American Locomotive Company.

At the Brooks Works of the American Locomotive Company a 10-wheel passenger locomotive has just been completed for the New Zealand Government Railways. As shown by the accompanying photograph, this is a neat and attractive design, somewhat heavier and larger than the Baldwin freight engine for the same road illustrated in our September number. The passenger engine has a Belpaire boiler, piston valves, extended piston rods and, except as to the running boards, sand boxes, and the arrangement of the front deck, strongly resembles American practice in light engines. The chief dimensions are as follows:



Narrow-Gauge Passenger Locomotive.—New Zealand Government Railways.

General Dimensions.

Gauge	3 ft. 6 ins.
Kind of fuel to be used	Bituminous coal
Weight on drivers	64,500 lbs.
Weight on truck	27,000 lbs.
Weight, total	91,500 lbs.
Weight of tender, loaded	57,000 lbs.
Wheel base, total of engine	18 ft. 3 ins.
Wheel base, driving	10 ft. 0 in.
Wheel base, total, engine and tender	40 ft. 6 ins.
Length over all, engine	29 ft. ¾ in.
Length over all, total engine and tender	46 ft. 9 ins.
Height, center of boiler above rails	6 ft. 8½ ins.
Height of stack above rails	11 ft. 5½ ins.
Heating surface, firebox	91 sq. ft.
Heating surface, tubes	1,260 sq. ft.
Heating surface, total	1,351 sq. ft.
Grate area	16.7 sq. ft.
Drivers, diameter	50 ins.
Drivers, material of centers	Cast steel
Truck wheels, diameter	30 ins.
Journals, driving axle	6½ ins. by 8 ins., with enlarged wheel fit
Journals, truck axle	4½ ins. by 8 ins.
Main crank pin, size	5 ins. dia. by 4½ ins. long
Main coupling pin, size	5½ ins. dia. by 3¾ ins. long
Main pin, dia. wheel fit	5¾ ins. dia.
Cylinders, diameter	16 ins.
Piston stroke	22 ins.
Piston rod, diameter	2¾ ins.
Main rod, length center to center	115½ ins.
Steam ports, length	17⅞ ins.
Steam ports, width	1¾ ins.
Exhaust ports, least area	25 sq. ins.
Bridge, width	2¾ ins.
Valves, kind of	Improved piston
Valves, greatest travel	4¼ ins.
Valves, steam lap (inside)	1 in.
Valves, exhaust lap or clearance (outside)	Line and line
Lead in full gear	1/16 in.
Lead, constant or variable	Variable
Boiler, type of	Improved Belpaire
Boiler, working steam pressure	200 lbs.
Boiler, material in barrel	Steel
Boiler, thickness of material in shell	½ in., 9/16 in. and 7/16 in.
Boiler, thickness of tube sheet	½ in.
Boiler, diameter of barrel front	51 ins.
Boiler, diameter of barrel at throat	55⅛ ins.
Boiler, diameter at back head	51 ins.
Crown sheet, stayed with	Direct stays
Dome, diameter	22 ins.
Firebox, type of	Sloping
Firebox, length	84 ins.
Firebox, width	29½ ins.
Firebox, depth, front	56 ins.
Firebox, depth, rear	48 ins.
Firebox, material	Steel
Firebox, thickness of sheets	Crown, ⅜ in.; tube, ½ in.; side and back, 5/16 in.
Firebox, brick arch	Self supporting
Firebox, mud ring, width	Back, 3 ins.; sides, 2½ ins.; front, 3½ ins.
Firebox, water space at top	Back, 4 ins.; sides, 4 ins.; front, 3½ ins.
Grate, kind of	Cast iron, stationary
Tubes, number of	220
Tubes, material	Steel
Tubes, outside diameter	1¾ ins.
Tubes, thickness	No. 13 B. W. G.
Tubes, length over tube sheet	12 ft. 7 1/16 ins.
Smoke box, diameter outside	54 ins.
Smoke box, length from tube sheet	55½ ins.
Exhaust nozzle	Single
Exhaust nozzle, diameter	3¾ ins. and 4 ins.
Exhaust nozzle, distance of tip below center of boiler	1 in.
Netting, wire or plate	Plate
Netting, size of mesh or perforation	¼ in. by 1¼ in.
Stack, straight or taper	Taper
Stack, least diameter	12½ ins.
Stack, greatest diameter	13¾ ins.
Stack, height above smoke box	30 ins.

Tender.

Type	8-wheeled steel frame
Tank, type	Straight top
Tank, capacity for water	2,100 gals.
Tank, capacity for coal	5 tons

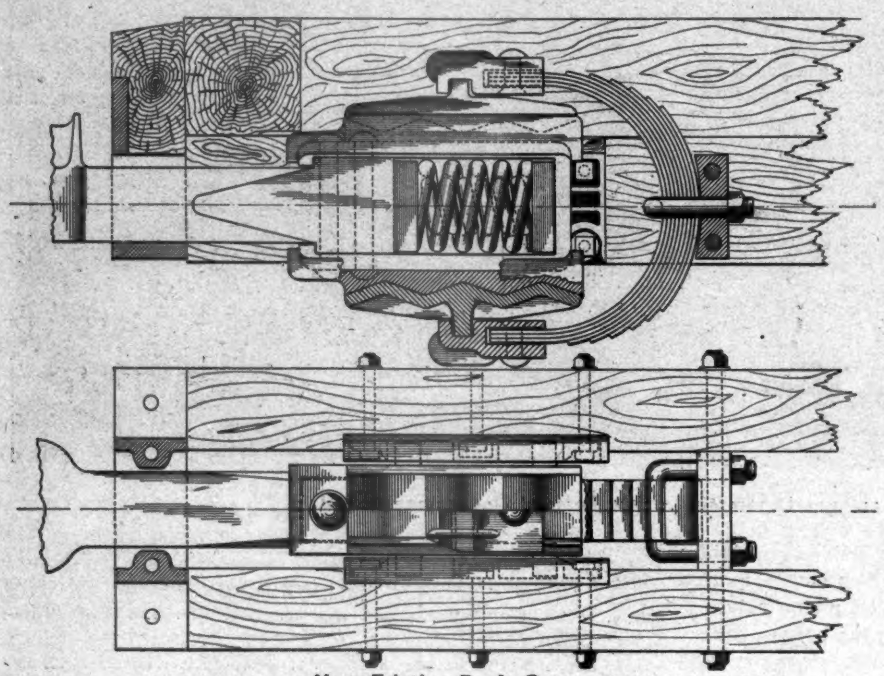
Mr. Lewis R. Pomeroy, who is well known to our readers, recently resigned his position with the Schenectady Locomotive Works to become special representative of the railway department of the General Electric Company, with office at 44 Broad street, New York. With the present activity in new shops and in rearranging old ones to secure the remarkable advantages of electrical distribution of power and the many questions which are continually arising concerning the application of electric traction to heavy railroad traffic, this field is a most important one, requiring the best attention of those who are conversant not only with the possibilities of electric machinery, but with the needs of the railroads in respect to it. Mr. Pomeroy combines these qualifications in an admirable way, and with his wide railroad acquaintance is prepared to fill a need which has long been felt. Both he and the General Electric Company are to be congratulated upon the appointment.

Mr. John E. Muhlfeld has resigned as Master Mechanic of the Montreal shops of the Grand Trunk Railway to become Superintendent of Machinery and Rolling Stock of the Intercolonial Railway, with headquarters at Moncton, N. B., to succeed Mr. G. R. Joughins, resigned. Mr. Muhlfeld is 29 years of age. He entered Purdue University in 1889, spending his summer vacations in construction work on the Peru & Detroit Railway, and as machinist and apprentice in the Fort Wayne shops of the Wabash. From 1892 to 1894 he was machinist and chargeman at Fort Wayne shops. Since this time he has worked through the responsible positions of roundhouse foreman, general shop foreman and general foreman in charge of locomotives and cars on the same road. In 1899 he became Master Mechanic of the Grand Trunk at Port Huron, Mich., and later transferred to the Montreal shops, which position he held up to the time of his present appointment on the Intercolonial.

NEW FRICTION DRAFT GEAR.

National Car Coupler Company.

A drawing of a new design of friction draft gear upon which a patent application has been filed, has been received from Mr. J. A. Hinson, President of the National Car Coupler Company, Chicago. Its object is to increase the resistance of the draft gear to withstand the shocks of pulling and buffing in such a way as to avoid the difficulties with increased recoil which



New Friction Draft Gear.

would be troublesome if the increased resistance should be introduced through the direct action of springs on the draw-bar. This construction makes use of a bow spring attached to the draft sills, the movable ends of which bear against two mating pieces with inclined faces which are capped over the draw-bar yoke. When the draw-bar is pushed or pulled, these inclines open the bent spring, causing an increased frictional resistance upon the movement of the draw-bar. The capacity of the spring may be made to suit the desired conditions. Its construction is such as to permit of attachment to any form of draft rigging using a draw-bar yoke. It has been specially designed to meet the requirements of cars now in service with inadequate draft gear, to which it may be easily applied in the shop. Further information may be had from the National Car Coupler Company, 621 Monadnock Building, Chicago.

A SHORT-SIGHTED POLICY AS TO SHOP MACHINERY.

The success of Andrew Carnegie as a manufacturer has been due in a large measure to his thorough understanding of the value of the most improved machinery and he has been spoken of as the greatest "scrapper," meaning that he has for years made apparently enormous sacrifices of good machinery simply because better and more productive machinery was available. The same is true to a greater or less degree of all manufacturers and is in marked contrast with the policy of nearly all railroads, as has been repeatedly indicated in these columns. Mr. H. F. J. Porter, of the Bethlehem Steel Company, made the following pertinent remarks on a subject closely allied to this, before the American Water Works Association recently:

"During a recent visit to the shops of one of the great trunk lines of the country, the writer was surprised to find that although all the men he met were intelligent and progressive in their ideas, he could discover no evidence of the application of these ideas in the adoption of modern methods of organization and management in the shops. Machinery and tools were old, and evidently the work they were doing was costing much more than it could have been done for elsewhere. On inquiry for the cause of this condition of affairs, the blame was laid on the Board of Directors, which, they said, looked upon the shops as a necessary evil and merely tolerated their existence, cutting down the amount of all appropriations asked for for new equipment. The superintendent of machinery said that after many futile endeavors to obtain an outfit of air-compressor and pneumatic tools, which are now the necessary adjuncts of every modern shop of the kind, he had actually started to build the whole thing himself. He said it would cost the road ten times as much as it could be bought for and take a long time to complete, but that the road would save money over present practice. It would seem as if in this case a 'getting together' of the powers for a full discussion of the situation would have uncovered the matter and that his usefulness to the road would in the future be diverted in another direction."

This, it must be admitted, does occur far too often and it reveals a deplorable lack of appreciation of the repair shop, but with keener insight into the meaning of locomotive statistics and with the increasing watchfulness of those who are most interested in comparing the cost of repairs, the number of such cases will rapidly decrease. The exigencies of the service and the large amounts invested in modern large locomotives will work a reform in this direction. We wish that every manager would consider Mr. Porter's criticism and suggestion as to "getting together." It would hasten the reform.

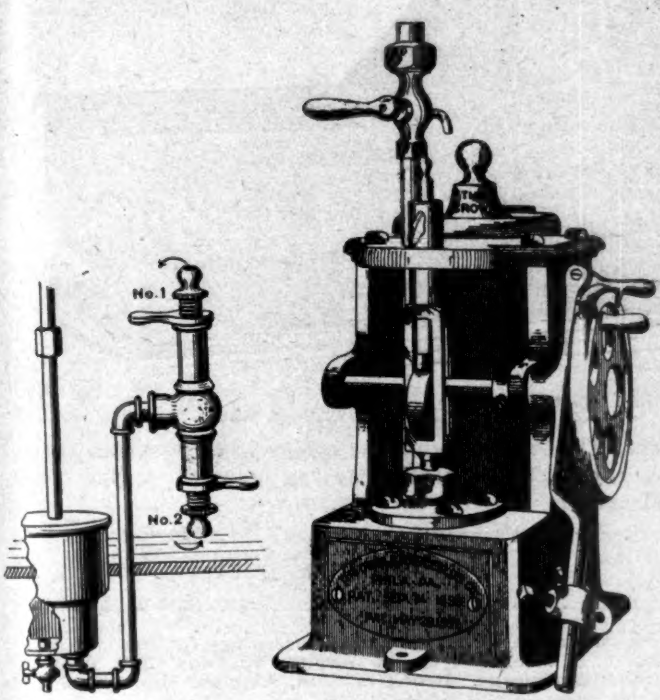
AIR FANS FOR COOLING AND VENTILATING PASSENGER CARS.

A very ingenious device has just been perfected by the Safety Car Heating and Lighting Company for cooling and ventilating passenger cars. The device consists of a system of fans, two of which are placed in each car and operated by compressed air, the air being supplied by an additional air-brake pump on the locomotive. From the engine the air is conveyed through the steam pipe the length of the train.

These air fans possess many inherent advantages over other styles of fans heretofore used. One of the principal advantages is found in the fact that the air is not only stirred up by the revolution of the fans, but a considerable amount of fresh cold air is introduced into the car as long as the fans are in operation. There is no motor used in this case, as the fans are made to operate as a reaction wheel, on the same principle as a garden sprinkler is made to turn by the flow of water. The fan, complete, weighs only 6 lbs., and can be placed in any position in the car that may be desired. A train on the New York Central Railroad has just been equipped with this system, and two fans have been in operation in a Pullman car running on the Erie Railroad, between Jersey City and Tuxedo, for some time. Only good reports have been heard from all those who have looked at the device, and there is no doubt but that its introduction will result in adding greatly to the comfort of the traveling public.

FORCE FEED LUBRICATING PUMPS AND DASH POT VALVES.

The Dorn & Marcellus Company, of Philadelphia, has placed on the market a force feed lubricator pump for lubricating the cylinders of steam engines, steam pumps, steam hammers, and pumping coal oil into the bottom of boilers to remove scale; also to lubricate the different bearings on all kinds of machinery and gear tools. These pumps, of which the accompanying engraving is a representative, are composed of very few parts, made of the best material, and consequently reducing the wear of the machine to a minimum. They are positive in their action, economical, safe and reliable, and are constructed with a cam motion, which does away with teeth on the gear wheel. The power necessary for operating the pump is taken from the eccentric of the engine, the pump being set in line with some working part of the engine



Dash Pot Valve. Automatic Lubricating Pump.

Manufactured by Dorn & Marcellus Company.

with a stroke not longer than three inches. The feeding is done automatically, starting the flow of oil as the engine starts, and cutting off the supply when the engine stops. To feed the oil by the drop or a continuous stream, the stroke is varied by moving a bar on top of the piston rod, thus giving a one-quarter, one-half, full stroke, or cutting off the supply entirely. These pumps are made to hold from ½ to 3 gals. of oil, with one to six pumps on the same shaft, and can be operated singly or severally, saving from 40 to 50 per cent. of oil.

The dash-pot valve, also illustrated in the accompanying cut, has become standard for the governing of the vacuum pots of Corliss and Green engines and ice machines. They cut off regularly, reduce the strain on the crab claws and are particularly valuable where great variations in load are encountered. The pistons can be made to lift from 25 to 50 lbs. easily, according to the size of the engine. Every dash-pot engine, old or new, should be equipped with these valves, as they will stop dancing and pounding in an engine. They are good for years of wear, as they contain no springs and have steel ball valves. There are thousands of these valves in use, reported to be giving universal satisfaction. The address of the Dorn & Marcellus Company is Mascher and York streets, Philadelphia, where information and printed matter can be obtained by those interested in dash-pot engines.

GEORGE WESTINGHOUSE ON CHEAP ELECTRICAL POWER FOR RAILROADS.

In a letter to the London "Times" concerning the advantages of electric traction for the transportation problem of London, Mr. George Westinghouse recently offered some important observations. As to the effect upon traffic he said:

"The electric propulsion of vehicles, already well extended, admits of such radical departure from the old way as to suggest that we may, by discarding many of our old ideas and methods, have a veritable revolution in the prevailing practice. This point is illustrated by the fact that an electric railroad, upon which single cars are run at frequent intervals for a distance of about 45 miles, parallel to one of the standard railroads in the United States, is, after being two years in operation, carrying twenty times as many passengers as were formerly carried by the steam railroad between the same points."

The large amounts of power required for heavy traffic render the selection of generating methods most important, and because of his prominence in the development of the large gas engine the views of Mr. Westinghouse on the possibilities of gas engines and producers for large units should be most carefully considered. He is a thorough believer in the internal combustion engine. On this subject he says:

"Of great importance to those who invest capital in these undertakings are the facts with reference to the cheaper generation of electric energy—which means the cost of power—since the first outlay for a plant is of far less importance than the continued cost of operation. The saving to be effected by the use of large gas engines supplied by producer gas will equal an amount which will represent an interest on about twice the estimated cost of a given power station of the modern type. The far-reaching effect of the cheap production of electricity can only be appreciated by going most carefully into the subject. Suffice to say, however, that it is only by means of a much cheaper method of generating electricity than by the use of steam engines of even the best type, that one can hope to effect such economies as will justify the great railroads in operating all of their suburban trains by electricity.

"Roughly stated, the expense for fuel and labor for the production of electricity by a gas engine equipment will not be greatly above one-third of that of the highest type of steam plant, while, in comparison with the average steam plant, the fuel consumption and cost will not exceed one-quarter. The decreased cost of production of electricity by means of gas engines, as compared with the present steam engine plants, would enable a board of trade unit to be sold at so low a figure as to justify a wide use of the electric current for cooking and heating purposes.

"In discussing the importance of the cheaper generation of electricity by means of gas engines and producer gas, one is met by much scepticism and frequently by the arguments of people having contrary interests. A sufficient answer to the sceptic and the interested party is the fact that apparatus will be supplied and results guaranteed. Representatives of large interests, ignoring what has heretofore taken place, have observed that to put in a large gas engine plant would be a great experiment; but on this point one may reply that it would be a much greater experiment to now establish a modern steam engine alternating generating plant, and in view of what can be accomplished with such economies with the gas engine, a far greater risk."

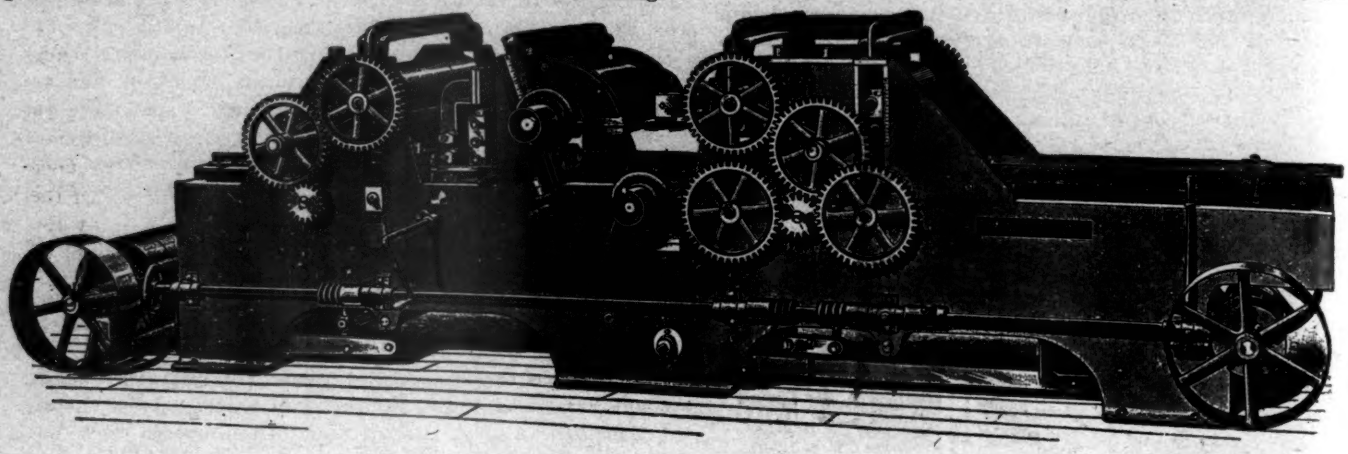
Prof. E. Josse, of the Royal Technical High School, of Berlin-Charlottenberg, in order to test the relative advantages of triple and compound expansion engines where superheated steam is used, recently made a number of experiments with the intermediate cylinder cut out. The engine used was a 150-horse-power triple-expansion engine, used for electric lighting and experimental purposes at that school. The results of the tests showed the economy to be precisely the same when two cylinders were used as when all three were in service.

HEAVY SILL PLANER, MATCHER AND TIMBER DRESSER.

The Bentel & Margedant Company.

This is not only a new machine, but is one of the largest of its kind ever built. It was designed specially for very heavy work, such as planing the four sides of car sills and dressing and matching other large timbers. It is known by the manufacturers as No. 74, and will plane two sides up to 24 by 8 ins., or four sides up to 20 by 8 ins. The design throughout is made to handle such heavy work as requires great strength and rigidity.

There are six feed rolls of large diameter, and large journals, powerfully driven by a train of large and wide-faced gears. The rolls are raised and lowered in massive housings by means of screws and a system of levers. All the rolls are raised and lowered simultaneously by power, by the operator at the feeding end, where the lever is conveniently located.



New Sill Planer, Matcher and Timber Dresser.

The lower head is placed in front, and operates on the material first, which is a feature to which special attention is called, because it provides a smooth surface for the material to slide upon and a surface from which to gauge and measure. It makes a division of the cut between the two heads and allows the parts of the machine to be brought close together. The head is carried in a heavy housing, which is made to slide entirely out of the machine for convenience in sharpening the knives.

Next to the lower head is the upper one, mounted rigidly in large housings, which are raised and lowered by two large screws. The bonnet chip breaker carries an adjustable shoe on the bottom, which may be set close to the knives, or it may be swung entirely out of the way for sharpening or adjusting them.

Housings of an entirely new construction are provided for the side heads. The lower end of the mandrel runs in a step box, where it rests in oil to keep it cool. The manufacturers state positively that it runs without heating. The heads run between two boxes, the upper one being removable to give access to the heads. The tables are cast solid and are provided with gauges and fences.

There are three speed changes in the feed, giving speeds varying from 30 to 65 ft. per minute, and the adjustment of the rate is made by changing the pulleys. Including the countershaft, the whole length of the machine is 17 ft., the width over all being 5 ft. 4 ins. Its weight is about 10,000 lbs., and it is furnished with two countershafts, one at each end. Jointer heads, 8 ins. long, or high, are furnished for the side mandrels. Further information may be had from the Bentel & Margedant Company, Hamilton, Ohio.

Mr. W. S. Aldrich, who was formerly of the firm of Smith & Aldrich, Consulting Engineers, Toronto, Ont., has been appointed to the directorship of the Thomas S. Clarkson School of Technology, Potsdam, N. Y.

LUNKENHEIMER PAN-AMERICAN EXHIBIT.

Visitors to the Pan-American Exposition who are interested in a line of superior brass and iron steam specialties and engineering appliances should not fail to visit the exhibit of the Lunkenheimer Company. This very complete and interesting exhibit is installed in section 46 of the Machinery and Transportation Building. Mr. F. S. Swanberg, who is in charge of the exhibit, will be pleased to explain the merits of these specialties. Among the products exhibited is a complete line of regrinding valves, handy valves, lever throttle valves, pop safety valves, plain whistles, chime whistles, fire-alarm whistles, injectors, sight-feed lubricators, oil cups, grease cups, glass cups, glass-body oil pumps, and a complete line of brass valves and fittings for marine work, in medium and extra-heavy patterns. The headquarters of the Lunkenheimer Company are in Cincinnati. The company also has branches in New York and London.

BOOKS AND PAMPHLETS.

Western Railway Club. Official Proceedings for the club year 1900-1901. Published by the Western Railway Club, Rookery Building, Chicago. Bound in cloth, standard size, 6 by 9 ins. Price, $2.00.

The very creditable work of this club for the past club year is just issued to its members in a bound and indexed volume. This is the only railroad club that sends out its proceedings in this form, and this is an excellent way to spend the accumulated funds of the club. By this method the membership is not only increased, but the value of the membership is enhanced. Copies of the proceedings can be had by addressing the Secretary, Mr. J. W. Taylor, 667 Rookery Building, Chicago. The price of the volume is $2, or the regular price of a year's membership.

American Railway Master Mechanics' Association. Proceedings of the Annual Convention, June, 1901. Edited by the Secretary, Mr. J. W. Taylor, Rookery Building, Chicago, Illinois.

The promptness with which the official proceedings of this association appear, in this case but twelve weeks after the close of the convention, is always a surprise. It indicates an activity by the secretary which is undoubtedly appreciated. This year, besides the reports, papers and discussions of the recent conventions, the volume contains the standards of the association complete, and a valuable record of the recommendations with reference to wheels, axles and rules for apprenticeship. In addition to these a summary has been prepared of the resolutions of the association with reference to matters of locomotive practice. These are placed in chronological order, beginning with the convention of 1873. This we consider a most important feature of this volume, and it should by all means be continued and kept up to date. In spite of the fact that the proceedings are now indexed from the beginning, the opinions of the association as established by vote may easily be overlooked, and this summary places them in convenient and readily accessible form.

Proceedings of the Air-Brake Association for 1901. Eighth Annual Convention, held at Chicago, April 30, 1901. Edited by Mr. F. M. Mellis, Secretary of the Association.

This volume of 267 pages contains, besides the regular business of the association and the president's address, the reports of the committees and the discussions in full. The subjects reported upon are as follows: The pressure retaining valve; standard form of questions and answers on the air-brake; terminal test plants; and unconnected hose vs. dummy couplings. The book is a uniform size with previous volume and is bound in paper and also in leather. The price in paper is 50 cents, and in leather 75 cents per copy.

The J. G. Brill Company, of Philadelphia, has just issued a small illustrated catalogue of snow plows for street and suburban railroads. The pamphlet presents a description of several different plows for handling snow and keeping railway tracks in working order through the most severe storms. Besides nose plows and shear plows for double track, a description of their combination electric locomotive snow plow and construction car is given, and also of the Brill track scraper. This catalogue, No. 68, is now ready for distribution.

The Boston Belting Company has just issued their new complete general catalogue of India rubber goods for all mechanical purposes. Besides the illustrations of all articles manufactured by this company and the tables of sizes and prices, the book contains a great many useful suggestions regarding the transmission of power, with rules and examples of how to find the arc of contact of a belt, the horse-power of any belt, the width required to do a given amount of work, the length of belt, directions for lacing, and other practical information concerning rubber belting. The illustrations and presswork of the book are of a high order, which, together with the very complete list of this company's products, makes it a very desirable catalogue. Those who are genuinely interested in mechanical rubber goods can procure a copy by addressing the Boston Belting Co., 256 Devonshire street, Boston, Mass.

Jeffrey Electric Locomotives.—A well-printed, finely illustrated pamphlet, received from the Jeffrey Manufacturing Company, Columbus, O., is devoted to the description of electric locomotives built by them for coal, iron, gold, copper and other mines, for steel works and other large industrial establishments. This company has made a specialty of this subject and is ready to submit specifications and guarantees upon inquiry. In addition to the illustration of locomotives and their parts, electrical equipment and mine rolling stock, the catalogue also contains information concerning other well-known specialties of this company.

Friction sensitive drill presses, with variable speed, without cone pulleys or the shifting of belts, are described in a little pamphlet by the Knecht Brothers Company, Cincinnati, O. The driving is done by an adjustable cone drive which permits of obtaining changes of speed very quickly and conveniently without requiring the operator to change his position. These machines are in satisfactory use on the New York, Ontario & Western, the Burlington & Missouri River, the Terminal Railroad of St. Louis, the Central Railroad of New Jersey, at the Richmond Locomotive Works and other establishments well known to our readers.

Ball and Roller Bearings.—We have received from Mr. W. S. Rogers, Vice-President of the Roller Bearing and Equipment Company, of Keene, N. H., a catalogue of ball and roller bearings, car side bearings and other railroad specialties, which is sure to interest our readers. Mr. Rogers is well known in connection with the Ball Bearing Company, of Boston. He continues the line of work in which he was so successful there, and has added to it the construction of roller side bearings for railroad cars of all classes and for trucks of all the well-known types. There is no better authority than Mr. Rogers in the selection of material and in methods of manufacturing. With a well-arranged factory, new machinery and workmen who have been with him for the past three years, he is in position to meet the most exacting requirements in the specialties mentioned. This catalogue contains a page of instructions to pattern makers, blacksmiths and machinists; also an advertisement and excellent engraving of a "Steamobile" upon the back cover.

The Westinghouse Pan-American Booklet.—This attractive and well-illustrated pamphlet gives a comprehensive idea of the industrial enterprise with which this company is associated, and pictures the very complete exhibits of this group of companies at the Pan-American Exposition, which occupy the central area of the electrical building and the southeast section of the railway building. These exhibits include a very large variety of electrical and railway equipment, much of which is of a new and interesting nature. The pamphlet is intended for distribution from the Westinghouse exhibits at the Pan-American.

Locomotive Data.—This very desirable little book is published by the Baldwin Locomotive Works, Philadelphia, Pa. It is pocket size, 3 by 5 ins., bound in leather, and contains 64 pages, including an index. The subjects treated in this second edition, such as the designation of different classes of locomotives, curves, curve resistance and how to find the radius of curves; hauling capacity; heating surface of tubes; horse-power; piston speed; properties of saturated steam; resistance due to speed, grade, curves, and acceleration of speed; tractive power, etc., are practically unchanged. Some new and convenient tables have been added, and an occasional short descriptive paragraph. The data brought together is of the most useful nature, making it a valuable reference book for all railroad men, and one which they will be glad to have conveniently at hand.

How to Keep Boilers Clean.—This pamphlet is issued by Leonard & McCoy, New York, and contains an illustrated description of the Hotchkiss mechanical boiler cleaner, which is a device for automatically removing all muddy solutions and sediments from the water in a boiler before they have a chance to form scale. Its application is shown to locomotive, marine, upright, flue, cylinder and tubular boilers. The pamphlet also gives some useful information on the subjects of Incrustation and Sediment in Boilers, The Care of Steam Boilers, Foaming and Priming, and The Use of Soda in Steam Boilers, together with valuable receipts, tables, etc. This pamphlet will be sent to those who will write to Leonard & McCoy, 161 Washington street, New York.

The American Steam Gauge and Valve Manufacturing Company, 188 Franklin street, Boston, has just distributed a new catalogue for 1901. It is profusely illustrated and the various specialties are briefly described. In addition to the usual improvements in former designs, this catalogue indicates additional specialties not contained in previous editions. These manufacturers give unusual attention to the testing of their product under actual working conditions, and it is said that, besides the United States Government testing equipment, there is no other equal to theirs in the country. The specialties of this catalogue include gauges and standard appliances for governing, indicating, measuring, recording and controlling steam, water, air, gas, oil and other pressures.

Electric Locomotives for Mine Haulage.—The Baldwin Locomotive Works and Westinghouse Electric & Manufacturing Company have issued jointly a catalogue of electric mine locomotives. The purpose of the book is to call attention to this most convenient and economical form of motive power for mine haulage. The catalogue illustrates a number of single and double-end electric locomotives, together with a brief description of the general features of construction of the latest and most approved types, and it also gives general information for use in determining the size and type of locomotive for general service. The latter half of the catalogue is devoted to illustrated details and a telegraphic code for use in ordering duplicate parts of locomotives. There is also inserted in the book a printed form to be filled out and sent for a preliminary estimate of the cost of electric mine haulage. The catalogue can be obtained from either the Baldwin Locomotive Works, Philadelphia, Pa., or the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

Graphite for Automobiles.—In this little pamphlet, issued by the Joseph Dixon Crucible Company, is printed the experiences of a number of prominent people, who have used graphite as a lubricant for steam, gas and electric automobiles. These experiences may be helpful to others who desire better running of their automobiles. Samples of this graphite compound are sent free to interested parties. The address of the Joseph Dixon Crucible Company is Jersey City, N. J.

The American Sheet Steel Company has just issued a finely-illustrated pamphlet, containing full-page engravings of a large number of their works throughout Pennsylvania and Ohio. A series of interesting views of the interior of a few of these works are also given. The last few pages of the book are devoted to tables of standard sizes of their various products, giving weights of sheets and bundles in pounds. Copies of this booklet will be sent to those who will address the advertising department of the American Sheet Steel Company, Battery Park Building, New York. It is one of the finest trade catalogues of the year.

Steam Hot Blast Heating and Drying Apparatus.—Thirty years of unrestricted progress has developed the Sturtevant products to meet the most peculiar requirements. The great diversity of sizes and arrangements is one of the essential features of these machines. This catalogue, just issued by the Sturtevant Company, shows the latest and most approved designs of exhausters and heaters, and combined fans and heaters. The construction and application of each of the various styles is described, and tables of sizes, weights and general information are given. A part of the pamphlet is given up to illustrations and descriptions of instruments for testing fan systems, and a large number of tables from which pressures in ounces may be transformed into pressures in inches of water, and vice versa. The B. F. Sturtevant Company, with address at Boston, Mass., are publishing independent treatises on ventilation and heating, and on drying, which illustrate the application of this company's apparatus for such purposes.

Summer Outings in California is the title of a very attractive pamphlet which is being distributed by the Atchison, Topeka & Santa Fe Railway. A brief description illustrated by many beautiful pictures of the coast and mountain regions of California is given in this pamphlet. The climate, cost of living and the joys of camp life are discussed. Information as to how to reach the resorts of California and the many places of interest just outside of Los Angeles and San Francisco are included, together with a large map of the Santa Fe lines, which lends its usefulness in planing these little excursions. The Santa Fe system is putting forth every effort to make their service to California the most pleasant and attractive to the large crowds of western tourists who are availing themselves of the considerably reduced rates.

EQUIPMENT AND MANUFACTURING NOTES.

Recognizing the fact that centrifugal force is proportional to the weights of the bodies in motion, and that water is nearly 1,600 times heavier than steam, the B. F. Sturtevant exhaust head was so designed that the exhaust steam is given a vigorous whirling motion within the case, thus throwing the water outward with such excessive force as to absolutely prevent its escape through the large central exit opening provided for the steam. The water, and likewise the oil, trickles quietly down the sides of the cage, which is in the shape of an inverted cone, and finally escapes through a special drip pipe at the bottom.

The Continuous Rail Joint Company of America has a complete outfit of special machinery that enables them to roll the continuous rail joint to fit perfectly any T or girder rail section used by steam or street railways. Ninety-two different rail sections are used by the one hundred and twenty-five railroads having this rail joint in successful operation. The rapid increase in engine and car loads has made the use of some form of base support necessary to give the required rigidity to the rail ends. The angle bar, while it has failed to do the work required, has yet some features that preclude its abandonment. These good features have been retained without the multiplicity of parts. The base plate, being an integral part of the joint, gives great horizontal and vertical rigidity, prevents any play between surface, and holds the rail ends in perfect line and surface. This rail joint is simple, complete and perfect in action, producing a remarkably easy riding track.

The address of the Continuous Rail Joint Company of America is 142 Market street, Newark, N. J. Circulars and full information will be sent on application.

During the week ending September 13th, the Pressed Steel Car Company shipped 628 cars, an average of 105 cars a day. The company is also making large shipments of truck frames, bolsters, brake beams, and other pressed steel specialties.

The increasing demand from railroads for locomotive injectors has made it necessary for the Lunkenheimer Company to materially increase the capacity of their injector department. Their '99 Model standard locomotive injector has been put through impartial tests that have proven the superior qualities of this machine.

In spite of the fact that large additions have been recently made to the plant of the Sargent Company at Chicago Heights, it has again been found necessary to extend them. This time it is the pattern shop which is found inadequate, owing to the large increase in the volume of business.

After severe tests with English built locomotives, the American Locomotive Company has secured an order for fourteen engines for the Cape Government Railroad of South Africa. The locomotives will be built on strictly American lines.

An important victory has been won by the Westinghouse Air Brake Company in their suit against the Christensen Engineering Company for infringement of the Boyden patent on quick action triple valves, by the granting of an injunction by Judge Lacombe against the latter company. In the opinion Judge Lacombe says, in part, of the Christensen valve: "It does not present the difference in form and principle which will distinguish it from the Boyden valve."

An idea of the enormous quantity of work turned out by the Pressed Steel Car Company can be gained by the following calculations. An average of over 1,600 tons of steel are used per day, or over 500,000 tons per year. In the four years during which the manufacture of pressed-steel cars has been carried on, up to September 1, 1901, this company has used about 1,657,-080,000 lbs. of iron and steel in the construction of the 46,030 cars which it has built. If these cars were placed end to end, allowing 35 ft. as the average length of the car, and 2 ft. for the couplings, they would form a continuous train 1,703,110 ft. in length, or over 322 miles. These cars would carry about 4,603,000,000 lbs. of freight, and the weight of the freight and cars combined would be 6,260,080,000 lbs., or 3,130,040 tons.

Among the railway exhibits at the Pan-American Exposition are those of the Consolidated Railway Electric Lighting and Equipment Company, of 100 Broadway, New York. The company exhibits its lights and fans on the special exhibition car of the Delaware, Lackawanna & Western, a special composite car of the Atchison, Topeka & Santa Fe, the "San Rafael," and includes also one of its refrigerator cars with its complete refrigerating equipment. The Santa Fe car is one of 106 cars equipped with this system on the road and includes fans as well as lights. These have been especially appreciated during the past season of extremely hot weather. This electric light and fan equipment may either be purchased at moderate cost by the railroads or it may be installed and maintained by the manufacturers upon a rental basis.

Mr. George W. Scott, for the past five years Mechanical Engineer of the Pullman Company, Pullman, Ill., has resigned to engage in business as consulting engineer, with office at 616 "The Rookery," Chicago, Ill. Mr. Scott has had a wide and varied experience in engineering and structural work and is well qualified to conduct a general engineering practice with reference to plans, specifications and estimates; examinations, valuations and reports of properties; investigation and development of mechanical undertakings; arrangement, construction and equipment of power plants, railroad and car shops, mills, works and factories; application of economical and cost-reducing methods in existing plants, shops and manufactories. Mr. Scott will be pleased to serve those who desire thorough, competent and responsible engineering services bearing on these subjects.